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Ground Water Monitoring Report

for the

RBT LANDFILL SITE
RIDGEFIELD, WASHINGTON

November 1987 through May 1988

Prepared for

PACIFIC WOOD TREATING CORPORATION
111 West Division Street
Ridgefield, Washington 98642

Prepared by

David J. Newton Associates, Inc.
1201 SW 12th Avenue, Suite 620
Portland, Oregon 97205

December 28, 1988

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DAVID J. NEWTON ASSOCIATES
INCORPORATED

Civil and Geological Engineering Services

January 6, 1989

Mr. Bryant L. Adams, Ph.D.
Environmental Engineer
PACIFIC WOOD TREATING CORPORATION
111 West Division Street
Ridgefield, Washington 98642

SUBJECT: Ground Water Monitoring Report for the Period November 1987 through May 1988; RBT Landfill Site, Ridgefield, Washington.

Dear Bryant:

We have prepared the report of ground water monitoring for the RBT Landfill Site during the period November 1987 through May 1988 according to your request. Six copies of the report are transmitted herewith for your use.

In general, the monitoring work for the 1987-88 wet season indicates that a seasonal perched ground water condition develops in the clean sand interbed that rests on top of the Troutdale Formation gravels. Since a temporary ground water condition develops, the opportunity exists to obtain samples of ground water and determine water quality characteristics for these samples relative to potential landfill leachate at a very early point in time should contaminants escape from the landfill.

Water quality data obtained from this monitoring work indicates that very low level contaminants were found in some, but not all samples obtained from the toe drain. Water samples from B-5 reflect no anomalus characteristics other than iron and coliforms.

The monitoring work for the 1987-88 wet season also indicates that some refinements in the existing monitoring system are needed. These include installation of two new wells and replacement of the existing well B-5. This results in a monitoring network that consists of the 3 new wells and the toe drain. The wells B-2, B-3 and B-4 could be abandoned. The wells B-1, B-6 and B-7 could be maintained in the system as observational wells. The new wells should be installed as soon as possible in order to provide information on the current wet season.

1201 S.W. 12th Ave., Suite 620 • Portland, Oregon 97205 • (503) 228-7718

If you have any questions regarding this report, Please do not hesistate to give me a call at (503) 228-7718.

This opportunity to be of service is sincerely appreciated.

Sincerely,

DAVID J. NEWTON ASSOCIATES, INC.

David J. Newton, P.E., C.E.G.
President

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RBT LANDFILL SITE
RIDGEFIELD, WASHINGTON

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REPORT OF MONITORING RESULTS

RIDGEFIELD BRICK AND TILE SITE LANDFILL

RIDGEFIELD, WASHINGTON

December 28, 1988

INTRODUCTION

This report presents the results of ground water monitoring at the Ridgefield Brick and Tile landfill site (RBT Site), located off 289th Street, west of Ridgefield (Figure 1). The monitoring work was performed in conjunction with closure procedures for the site, and responds specifically to recommendations made in the Progress Report, Geological and Groundwater Site Characterization, Ridgefield Brick and Tile Site (RBT Site), Ridgefield, Washington, David J. Newton Associates, Inc., September 27, 1987.

The investigation work for the above referenced report indicates that favorable stratigraphic conditions exist at the RBT Site for monitoring potential seasonal perched ground water. Specifically, the monitoring zone consists of relatively clean permeable sand sandwiched between overlying low-permeability silty to clayey soils, and underlying dense, low-permeability silty to clayey weathered gravels of the Troutdale Formation. The lined bottom of the landfill appears to be within the sand phase of the stratigraphic section at the RBT Site.

The principal aquifer in the area is approximately 180 feet below the RBT Site and is hydraulically remote from the landfill by virtue of depth, and low-permeability strata between the landfill and the aquifer. Based on these conditions and the presence of the clean sand interbed at or near the bottom of the landfill, monitoring wells constructed to intake water from the clean sand interbed will provide the earliest opportunity for leachate detection if leachate carrying contaminants escapes from the bottom of the landfill. Therefore, monitoring of the seven wells was conducted during the 1987-88 wet season in order to determine if a seasonal perched ground water condition develops in the sand interbed that would represent a contaminant transport medium, and to determine the quality of water obtained from the wells. The results of this monitoring work are the basis for refinement of the RBT Site monitoring system as part of the landfill closure process.

MONITORING METHODS

MONITORING WELLS

Monitoring wells were installed on the site during August, 1987, at 7 locations designated B-1 through B-7, as shown on Figure 2. The wells were installed to monitor both the clean sand interbed and underlying gravels for seasonal ground water. The monitoring wells B-1, B-5, and B-6 are constructed with slotted water intake sections that have hydraulic communication with the clean sand interbed and the upper part of the Troutdale Formation gravel unit. The clean sand interbed was not encountered during drilling and sampling of borings for wells B-2, B-3, and B-4. The clayey silt cap unit found in all borings drilled during the 1987 exploration extended in these latter borings, to the top of the Troutdale Formation gravel unit, indicating the sand interbed is discontinuous on the west side of the landfill. Therefore, wells B-2, B-3, and B-4 are constructed with water intake sections located in the upper, low-permeability part of the gravel. The intake sections of B-2 and B-3 extend from the gravels upward into the clayey silt cap unit. The approximate locations of the slotted intake sections relative to the clayey silt, clean sand, and gravel stratigraphic units at the site are illustrated on the attached Figure 3.

The seven wells installed on the RBT Site are equipped with security casing and lock systems to protect the wells from tampering and introduction of foreign materials into the wells. The wells were also sealed with bentonite backfill from the sandpack above the slotted pipe section to the ground surface. The wells are constructed of 2 inch diameter threaded PVC pipe equipped with slotted sections at the monitoring zone. The slot width is 0.02 inches. The annular space between the boring wall and the pipe at the monitoring zone was backfilled with NO. 8 silica sand. Periodic measurements were made in the wells to determine the presence of ground water. Water samples were obtained and subjected to laboratory testing for water quality determinations.

A. GROUND WATER DETECTION

Measurements of the wells were made on a periodic basis, extending from November, 1987 through May, 1988. The wells were checked for ground water presence with an electric probe suspended on a cable that was marked with depth indicators. This work was done by Dr. Bryant Adams of Pacific Wood Treating Corporation. In some cases, assistance was provided by representatives from David J. Newton Associates, Inc. (DNA), particularly where sampling was involved. Representatives from Tetra Tech, Inc., of Bellevue, Washington, assisted with ground water detection checks and sampling on May 23, 1988.

B. WATER QUALITY

Water samples were obtained from the well B-5 and from the landfill toe drain at various times during the monitoring period identified above. In most cases, the samples were obtained by Dr. Adams of Pacific Wood Treating Corporation.

Sampling assistance was provided on January 29, and May 23, 1988 by representatives of DNA. Water samples were obtained from B-5 and the toe drain with a standard 1-liter, cord-suspended teflon bailer. As observed during sampling, procedures were carried out to recognized procedures for packaging samples and preventing contamination of the samples, including cleansing and rinsing of the sampling equipment. Chain-of-custody documents were prepared for the samples to document their handling and transport from the RBT Site to the testing laboratory. Additional water samples were obtained from B-5 and the toe drain on April 26, 1988, by Pacific Wood Treating personnel. The samples from both sampling events were delivered to Columbia Analytical Services, Inc., by Dr. Adams.

MONITORING FINDINGS

A. GROUND WATER PRESENCE

1. Ground Water Amounts and Times of Detection

Ground water was detected in the 3 monitoring wells with clean sand interbed communication during the portion of the wet season between December 1987 and April 1988 after an initial fall season "dry" period. The maximum recorded water depths above the bottom of the wells were measured at 1 foot in well B-1, 8 to 9 feet in well B-5, and 8 inches in well B-6. The duration of water in the wells varied from approximately 2 months (January-March) in well B-1, to approximately 4 1/2 months (December-April) in well B-5, to approximately 1 month (late March-early April) in well B-6.

Trace amounts of ground water were recorded for the remaining wells. These include wells B-2, B-3, and B-4 installed in the low-permeability clayey silts and upper portion of the gravels. Although the sand interbed was penetrated in monitoring zone of well B-7, it appears that the silt and clay fraction of the sand matrix has increased in response to the proximity of the well to the terminus of the sand phase west of the landfill as illustrated on Figure 3. This condition would, in effect, reduce the permeability of the sand and the probability of ground water reaching the well intake section.

2. Probable Ground Water Source Considering Precipitation and Water Quality

Relationships between the depth of ground water above the bottom of well B-5 and precipitation events recorded by Dr. Adams of Pacific Wood Treating Corporation for Ridgefield are illustrated on Figures 4 and 5, respectively. These records reflect an apparent time lag of 1 1/2 months between precipitation event and an increase in water depth above the bottom of well B-5.

Laboratory tests on samples of ground water from well B-5 indicated the presence of coliform. We understand that a drainfield for a septic waste disposal system is located on residential property within 100 feet or less to the east and upslope from well B-5. This condition, combined with the response time characteristics indicated by Figures 4 and 5, suggests that the clean sand interbed is recharged by infiltrating surface waters. These conditions also suggest that the recharge occurs near the site.

3. Findings Relative to the Ground Water Response of Well B-5

The maximum measured depth of ground water above the bottom of a well applies to well B-5. A probable explanation is the storage capacity in the slotted section that extends below the clean, permeable sand interbed, into the less permeable gravel unit. Well B-6, located down-gradient from well B-5, has very little storage capacity below the permeable sand since the lower portion of the boring was sealed with bentonite and the bottom of the well was established near the top of the gravel unit. Therefore, a temporary saturation zone extending from the top of the perching gravel unit a few inches into the clean sand interbed would result in a significant reduction in "storage" for the B-6 well. Well B-1 extends into the gravel unit approximately 5 feet, resulting in some increased storage potential.

4. Stratigraphic Control on Ground Water Flow and Findings Relative to Monitoring Well Locations

Stratigraphic boundaries exist at the landfill site that control lateral migration of temporary ground water. The top of the Troutdale gravel unit slopes away from the well B-5 area and the landfill, toward the south-southwest, apparently toward the northwest. The clean, permeable sand interbed resting on the top of the gravel unit pinches out in the westerly direction, as illustrated on the east-west section through the site shown on Figure 3. Therefore, components of lateral ground water flow that may be inclined to move toward the west from the B-5 and upgradient areas are stopped by the barrier of clayey silt that rests directly on top of the gravels, in the absence of the permeable sand interbed. This barrier condition will confine lateral flow of ground water perched in the clean sand interbed toward the south, in the downgradient flow direction, beneath the landfill. Therefore, the opportunity for ground water sampling can be enhanced by installing a monitoring well near the southwest corner of the landfill, and at a location near the well B-6, south of the landfill boundary. These stratigraphic barrier conditions and locations for monitoring wells are illustrated on Figure 6.

5. Dissipation of Ground Water From Well B-5

The dissipation of water from well B-5 was also examined. The boring log for B-5 records a 6 inch thick sand layer in the Troutdale Formation gravels. The layer is located at the bottom 6 inches of the boring, 9.5 feet below the top of the gravel unit. The sand layer is within, or very near the slotted pipe section of the well. In addition, the sand matrix of the gravels appears to be cleaner than the low-permeability sand, silt, and clay matrix observed in the upper 5 to 10 feet of the gravel unit. It is possible that drainage of B-5 could occur through the sand layer, and the cleaner gravel materials that may be present beneath the upper weathered cap of the gravel unit.

6. Ground Water Findings Relative to the Troutdale Gravels

The locations of the monitoring zones for the wells were re-examined considering the possibility of a seasonal water bearing zone in the upper part of the Troutdale Formation gravels. The cross-section illustration on Figure 3 indicates that the depth of penetration of well B-5 into the gravels is consistent with most of the other wells. Therefore, the possibility of B-5 tapping a water zone in the gravel due to a deeper penetration is unlikely. Also, since an 8 to 9 foot water depth in B-5 results in a water level near the top of the gravels, this amount of head would likely result in notable water levels in the other wells that penetrate the gravels to depths similar to B-5.

B. **WATER QUALITY**

Water samples were collected from well B-5 and the landfill toe drain on January 29, 1988. The samples were analyzed by Columbia Analytical Services, Inc., of Longview, Washington. The samples were analyzed for pesticides, herbicides, metals, TOC, TOX, coliform, and other standard drinking water parameters. The test results indicate that the sample from B-5 was high in iron, turbidity, and coliform. No other anomalous water quality characteristics were indicated by the test results, including those for the landfill toe drain.

Water samples were obtained from B-5 on April 5, 1988. This sample was analyzed for TOC, TOX, conductivity, and metals. As for the January results, no reason is evident to suspect contamination of the ground water sampled from B-5.

Samples were obtained from the toe drain during a coorperative effort between the EPA consultant, Tetra Tech, Inc., of Bellevue, and Pacific Wood Treating Corporation, on May 23, 1988. The EPA analyzed four samples for polynuclear aromatic hydrocarbons (PAHs) and chlorophenols. The compounds phenanthrene, fluourene, naphthalene, anthracene and fluoranthene were detectable in some samples, but not in all of them. These PAHs were detected at very low levels, with the highest value measured at approximately 2 ppb. Of the chlorophenols tested, pentachlorophenol and 2,3,4,5-tetrachlorophenol were detected in some samples, but not all of them. These compounds were also present at very low levels, with the highest concentration at just 1 ppb.

Toe drain samples collected on May 23, 1988, were analyzed for pesticides, herbicides, metals, TOC, and TOX and other water quality parameters. This sample had a higher TOC than normal and also had a significant level of coliforms. Pentachlorophenol was measured at 2 ppb. Other organic chemicals were not detected.

The results of tests performed by Columbia Analytical Services, Inc., and United States Testing Company, Inc., at the request of Pacific Wood Treating Corporation, are presented in the Appendix.

CONCLUSIONS

1. Temporary, seasonal ground water perching occurs in the clean sand interbed that rests on top of the Troutdale Formation gravels.

2. The maximum recorded ground water depth above the bottom of well B-5 is the probable result of temporary storage in the

slotted pipe section of the well that extends downward, into the low-permeability gravel unit, below the water-bearing phase of the sand. The limited ground water response recorded for well B-6 is the probable result of a lack of "storage" capacity in the well since the bottom of the well pipe is located in the sand, above the low-permeability gravel. Based on these conditions, the 1987-88 wet season ground water condition resulted in saturation of the lower few inches of the sand, reflected by the shallow depth of water reported for the well B-6. Saturation of the full thickness of the clean sand interbed would reflect a water level depth of approximately 6 feet above the bottom of B-6.

3. The lack of ground water recorded for the wells B-2, B-3, and B-4 results from the absence of the clean, permeable sand interbed at the top of the Troutdale Formation gravel unit. Ground water migration to these wells is prevented by the low-permeability clayey silt soil unit that rests directly on top of the gravel unit. Therefore, ground water perching above the gravels, in the clayey silt unit, is improbable.

4. The permeable sand interbed above the gravels and the seasonal perching of ground water on top of the gravels, in this interbed, supports the use of a shallow ground water monitoring system for the RBT Site. The shallow system provides the opportunity to detect landfill-related ground water contamination, if it occurs, at the earliest date.

5. The permeable sand interbed is discontinuous in the westerly direction from the landfill. The sand pinchout in low-permeability clayey silt results in a barrier condition for potential westerly ground water flow components. Since seasonal ground water perching occurs at the RBT Site, the opportunity to sample ground water that has passed beneath the landfill will be provided by additional monitoring wells installed in the sand interbed at downgradient locations near the southwest corner of the landfill, and near well B-1 B-6, south of the landfill boundary.

6. No evidence was found to support the presence of a seasonal water table condition in the depth interval of the gravel unit penetrated by the slotted section of the monitoring wells.

7. Water quality testing of samples from the landfill toe drain by separate, independent laboratories indicate that contaminants can be detected at very low concentrations in

some, but not all toe drain samples. Water quality testing of samples from monitoring well B-5 detected no contaminants that were found in the toe drain samples.

8. Based on the results of the 1987-88 wet season monitoring at the site, refinements in the monitoring well system are necessary. These are:

   A. Abandon well B-5 according to proper sealing procedures and construct an upgradient replacement well near the B-5 location. The purpose of this well replacement is to prevent migration of ground water from the clean sand interbed, through the well, into the apparent cleaner, more permeable gravels beneath the upper weathered cap of the gravel unit. The bottom of the slotted intake section of the new well should be positioned on top of the gravel unit so that the monitoring zone is entirely in the sand interbed above the gravel unit. The length of the slotted water intake section should be 10 feet and a pipe diameter of 2 inches should be adequate for the well.

   B. Construct two additional monitoring wells adjacent to the south boundary of the landfill. One well should be positioned near the southwest corner of the landfill and the other well should be positioned near well B-6, south of the landfill boundary. These wells are in the downgradient direction based on the slope of the gravel/sand interbed contact. The bottom of each well should be positioned on top of the gravel unit so that the monitoring zone is entirely in the sand strata above the gravel unit. The length of the slotted water intake sections should be 10 feet and a pipe diameter of 2 inches should be adequate for the wells. The sand or gravel pack enclosure around the slotted pipe section, and the slot size of the pipe should be developed according to the grain size characteristics of the sand phase in the monitoring interval with the finest grain size fraction.

   C. Considering the potential for a thin zone of saturation on top of the gravel, refinements in the well construction are needed. Sampling "reservoir" capacity for the wells could be achieved by extending the well below the slotted intake section with solid pipe. This would allow short-term storage of water for sampling, and prevention of water migration, during temporary storage periods, through the well into potentially permeable gravel zones beneath the upper weathered cap.

This would require extension of the boring into the gravel unit to a 10 foot depth. This could be accomplished by installing the pipe and sealing the annular space between the pipe and the boring wall with bentonite clay.

D. The usefulness of wells B-2, B-3 and B-4 is diminished. These wells could be abandoned according to accepted abandonment procedures. Wells B-1, B-6 and B-7 could have observational value and the wells could be maintained for continued monitoring use.

E. Periodic measurements, sampling and water quality testing in accordance with regulatory procedures and the closing plan for the RBT Site will provide the opportunity for detecting contaminants that may be related to the landfill on a timely basis.

RECOMMENDATIONS

Based on the above considerations and conclusions, we recommend that closure proceedings for the RBT Site continue to completion with installation of the monitoring system refinements identified above.

We recommend that the shallow monitoring system concept be continued on the RBT Site on the basis that this approach provides the greatest opportunity to detect contaminants that may be related to the landfill at the earliest time. We recommend that periodic sampling and testing be accomplished for the toe drain (considered as a down-gradient source), the well B-5 replacement, and the two additional monitoring wells to be constructed near the southwest and southeast corners of the landfill. Prior to ground water sampling, the wells should be vacated of water according to standard pre-sampling practice in order to allow sampling of waters from the formation material as the water level recovers in the well.

Construction of the B-5 replacement well and the two new wells should be accomplished according to the accepted procedures and requirements of the EPA relative to materials, gravel or sand packs, seals, and security.

We recommend that the new wells be installed as soon as practicable in order to provide sampling opportunities during the current wet season.

We recommend that monitoring results are documented and reviewed for confirmation of the monitoring approach and to evaluate the need for refinements in the monitoring system. We recommend that the results of monitoring from the above system refinements be submitted to the EPA in December, 1989 for updating the project files and closure records.

FIGURES

1. 26

PROGRESS REPORT

GEOLOGICAL AND GROUNDWATER SITE CHARACTERIZATION

AND GROUNDWATER MONITORING

September 27, 1987

Prepared For

PACIFIC WOOD TREATING CORPORATION

RIDGEFIELD BRICK AND TILE SITE (RBT SITE)

RIDGEFIELD, WASHINGTON

RCRA DOCKET NO. 1085-09-26-3008P

Prepared By

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PORTLAND, OREGON 97205

1.00 INTRODUCTION AND BASIS FOR SITE CHARACTERIZATION AND MONITORING

The Ridgefield Brick and Tile Site (RBT Site) is located west of Ridgefield, Washington on 289th Street as shown on the attached Vicinity Map (Figure No. 1). The site is owned by Pacific Wood Treating Corporation (PWTC).

A landfill has been designed and built on the RBT Site to contain waste material from the PWTC operation in Ridgefield. Construction of the landfill was to implement closure of the facility under supervision of the Washington State Department of Ecology, and the EPA. These closure activities were completed between September 1983 and January 1984. Reports prepared in conjunction with these closure operations include the following:

1. RBT Site, Preliminary Ground Water Investigation, Sweet, Edwards & Associates, Inc., 1983.

2. Draft Closure Plan For Ridgefield Brick and Tile Site, Ridgefield, Washington, Sweet, Edwards & Associates, Inc., 1983.

3. Addendum To Draft Closure Plan, Ridgefield Brick and Tile Site, Ridgefield, Washington, Sweet, Edwards & Associates, Inc., 1983.

4. Report On Certification of Closure Of The Ridgefield Brick and Tile Site, Ridgefield, Washington, Sweet, Edwards & Associates, Inc., 1984.

Further closure requirements for the RBT Site, under Federal Regulations, include installation and maintenance of a ground water monitoring system. This is required during the closure and post closure period for landfills.

Though some monitoring provisions were installed on the RBT Site with lysimeters during the closure activities, additional ground water monitoring provisions have been declared necessary by EPA to meet regulatory requirements. Specifically, these monitoring provisions are:

1. Installation of a ground water monitoring system which would comply with the requirements of 40 CFR Part 265, Subpart F.

2. Compliance with the hydrogeologic information requirements of 40 CFR 270.14 (c).

In response to these needs, PWTC engaged David J. Newton Associates, Inc., to perform additional test drilling, sampling and testing to further characterize the subsurface conditions at the RBT Site, and help indentify a ground water monitoring system. This Progress Report presents the results of investigations, monitoring well installations, and conclusions made to date on the project.

2.0 APPROACH

2.1 SITE CONDITIONS

There are two significant strata groups beneath the RBT Site. The upper 15 to 30 feet thick depth interval consists of clayey silt and sand. The lower strata consists of dense gravels, referred to as cemented gravels in previous site reports and by well drillers. The gravel unit is 25 to 40 feet beneath the RBT Site and is identified as the Troutdale Formation in the previous reports referenced above.

The dense gravel unit prevails in the Upper Troutdale Formation. The thickness of the gravel unit beneath the RBT Site based on well logs is approximately 80 feet.

The Lower Troutdale Formation consists primarily of silts, clays and sands. The regional water supply aquifer in the RBT Site area is in a sand unit of the Lower Troutdale Formation. The depth of the aquifer beneath the RBT Site is approximately 180 feet.

It has been postulated that a seasonally saturated condition develops on the top of the Troutdale Formation. The top of this Formation is thought to be irregular and could result in local ground water accumulations if low permeability conditions promote perched water conditions. Since this is a seasonal condition, the accumulated water must migrate either laterally along the surface of the Troutdale Formation, or vertically into the Formation. If vertical percolation of this water into the Troutdale Formation is occurring, then there is hydraulic connection between the top of the Formation and the regional water supply aquifer within.

The question of whether lateral or vertical migration is occurring at the surface of the Troutdale Formation is significant only if a vehicle exists to transport possible contaminants from the RBT Site down to the Troutdale Formation.

2.2 METHODS OF INVESTIGATION

The ability of contaminants to migrate to a water supply aquifer depends on the presence of water to transport the contaminants, and the ability of the transport water to percolate downward through geological formations that separate the landfill from the water supply aquifer. Therefore, the presence of water in the formations encompassing the landfill, permeability of the formations, and influence on the presence of water and its downward percolation ability by stratification of materials with different properites are very important site characterization elements for planning and implementing monitoring systems. These elements are the basis for the methods used to characterize the RBT Site.

The principle objective of site investigations was to determine the presence of water, permeability of formation materials, and identify the physical characteristics of the various strata present at the RBT Site. Since the cemented gravels appear to perch water that results in a postulated seasonal saturation zone in overlying sands, the focus of the site investigation extended between the ground surface and the upper 10 feet of the cemented gravels. This was done in order to determine if transport water is present, and if present, how it could migrate from the landfill site. Identification of these conditions will help determine a monitoring system that will provide useful and timely water quality information for the RBT Site.

In order to identify the subsurface strata present at the site, and obtain high quality samples for laboratory analyses, 7 borings were extended through the clayey silt and sand unit into the underlying cemented gravels. The borings were extended with a truck-mounted, 10 inch O.D. hollow stem auger. The boring locations are presented on the attached Figure No. 2.

Samples were obtained with a 3 inch O.D. split-spoon sampler typically used in geotechnical engineering practice for retrieving samples for characterization of their physical properties. Initially, samples were obtained on a continuous basis. However, uniform soil conditions were recognized in the borings and the sample depth interval was adjusted to 2.5 feet. If changes in soil conditions were observed, samples were obtained accordingly.

The split-spoon sampling procedure provided cores of the earth materials penetrated by the borings. Field examination of the cores indicated the textural characteristics of the materials, stratigraphic sequences, and moisture conditions. Moisture content determinations were made during drilling operations with a field oven. The results of these tests were used to investigate if local saturation zones were present in the depths penetrated by the borings. Undisturbed cores were sealed in air-tight plastic containers for transport and storage prior to testing.

Laboratory tests were performed on representative samples from each stratigraphic unit penetrated by the borings. The tests were performed by Dames and Moore. The tests included permeability, grain size analysis, plasticity characteristics, natural dry density, and natural moisture content. The results of the tests are summarized on the attached Figure No. 3.

Investigation of the deeper stratigraphic aspects of the Troutdale Formation, and the regional water supply aquifer in the Troutdale Formation was accomplished by review of well logs obtained from the Washington State Department of Ecology. Logs were obtained for the area within a 1 mile radius of the RBT Site to determine the nature of the Troutdale Formation strata reported by drillers, depth to the regional aquifer, and the locations of wells that tap the aquifer relative to the RBT Site. This information was used to evaluate the potential for transport water to carry contaminants and actually reach the regional water supply aquifer.

Geological conditions within a several mile radius of the RBT Site were identified in the USGS Water-Supply Paper 1600 (Geology, Ground Water, Clark County, Washington). This information indicated the locations and elevations of the Troutdale Formation outcrops in the general site area. Since the top of the Troutdale Formation is postulated to intermittently perch water, the land surface area available to collect precipitation, and provide water that would percolate downward to the top of the Formation is very important for transport water availability. Therefore, topography of the area within a several mile radius of the RBT Site was examined to identify where the top of the Troutdale Formation was intersected by erosion. This process indicated that the RBT Site location is bounded on 3 sides by drainage systems that have eroded below the top of the

Formation, cutting off possible lateral ground water flow that might come from the north, east or west. Some lateral flow on top of the Formation could reach the site along the narrow ridge that extends south from the site. Otherwise, the recharge area for supplying the postulated intermittent saturation zone is relatively small.

3.0 SITE CHARACTERIZATION

3.1 GEOLOGICAL MATERIALS

Drilling, sampling and laboratory testing to investigate the RBT Site confirmed that two basic stratigraphic units underly the site. The upper unit is clayey silt. The lower unit is cemented gravel of the Troutdale Formation. In 4 of the 7 borings drilled on the site, a sand unit was encountered between the clayey silt and the gravels. These units are described below, and illustrated on Figure No. 4.

3.11 Upper Clayey Silt Unit

Clayey silt was encountered in each of the 7 borings drilled on the RBT Site. These soils are characterized by mottled brown, gray, orange to black colors, and prevalence of fine-grained silt and clay particles in the matrix.

Grain size analyses indicate that the fraction of the samples finer than the No. 200 standard sieve is 90 to 100 percent by weight. The natural dry density of the tested samples ranges from 95.3 to 102.4 pounds per cubic foot which indicates that the clayey soils are relatively dense. Moisture content tests indicate values in the 19 to 27 percent range. Field examination of core samples indicated that this wet condition prevailed between depths of approximately 3 feet to the bottom of the clay silt unit.

The degree of saturation was estimated for the clayey silt samples by calculating the volume of void space from the dry density of the soil. These calculations indicate that the moisture content to fill all voids in the clayey soil at the densities determined from testing ranges from 24 to 28 percent. Comparison of these values with the actual moisture content of the tested samples indicates that the clay soils are at, or very near saturation (88 to 100 percent for 6 of 7 moisture determinations). This moisture condition for the clayey soils at the latter part of the dry season (August) indicates that the clayey soil unit is holding water and very little, if any, drainage through the unit is occurring. The upper 2 to 3 feet of the unit is drier. This condition reflects the loss of moisture from the near surface soils by evapotranspiration.

An undisturbed shelby tube sample of the clayey silt was tested for permeability under vertical and lateral confining pressures representative of field conditions. The permeability was determined to be 1.55 X 10E-6 centimeters per second. This is 0.0044 feet per day, or 1.6 feet per year.

For a one year period, this indicates that water in the lower 1.6 feet of the clayey silt unit could drain into the underlying sand unit. Since the permeability of the sand unit is higher, and drainage will occur much faster, the water contribution from the clayey silt to the postulated intermittent saturation zone on top of the gravels is relatively small.

3.12 Sand Unit

The sand unit encountered in the borings consists of two phases. The upper sand phase contains a significant fines (silt and clay) fraction that ranges from 25 percent in one sample, to 40 percent in two other samples (grain size distributions for samples from borings B-5 and B-6 are in the summary of test results attached). The percentage of fines in the sand decreases in the downward direction, ultimately grading to a relatively clean, well sorted sand that characterizes the lower sand phase.

Moisture content tests on samples from the silty to clayey upper sand phase indicates the degree of saturation is approximately 90 percent for the top of the phase, and approximately 60 percent for the bottom of the phase.

Moisture contents for samples from the clean, lower sand phase indicate the degree of saturation is in the 40 to 50 percent range for the middle and upper portions of the phase. Moisture test results for the sand near the contact with the underlying cemented gravels indicate moisture conditions at approximately 75 percent of saturation.

These moisture conditions reflect the lower permeability of the upper sand phase and associated water retention by silt and clay fines. The lower sand phase is more permeable and free draining. Permeability estimates were made for these sand phases on the basis of grain size distribution since these materials are permeable relative to the clay and gravel deposits. A permeability range of 10E-5 to 10E-3 centimeters per second is conceivable for the upper sand phase. These estimates correspond approximately to a range of 0.1 to 3 feet per day. The permeability of the lower clean sand phase is estimated in the range 10E-3 to 10E-2 centimeters per second, or approximately 3 to 30 feet per day.

The sand phases were not encountered beneath the clayey silt unit in borings B-2, B-3 and B-4 located west of the landfill site. However, they were encountered in borings B-1, B-5, B-6 and B-7 located near the respective east, north, south and west landfill boundaries. The sand phase pinches out in the westward direction from the landfill and thickens in the easterly direction. Thickness contours are on Figure No. 5.

The thickness of the upper sand phase varies from 8 to 14 feet where penetrated by borings. The thickness of the lower clean sand phase was measured at 2 to 7 feet where penetrated by borings.

3.13 Gravel Unit (Troutdale Formation)

Gravels were encountered in all 7 exploratory borings drilled on the RBT Site. Penetration depth into the gravel deposit by the auger drill is limited by refusal conditions. Penetration depths varied between 5 and 10 feet.

Cores of the gravels were obtained with the split-spoon sampler and were subjected to laboratory analyses to identify physical characteristics. Field examination of the gravel cores indicated that the clasts are rounded, generally in the 0.5 to 1.5 inch size range, and are weathered. Some clasts could be broken by finger pressure.

The clasts are fully supported in a silt, clay and sand matrix with a dense, coherent fabric. Grain size analyses indicate the samples actually class as Silty Sand. The gravels are weathered and cementation is the apparent result of weathering products in the matrix that include clays. Samples of the gravels were moist, and mottled coloration varied from brown, orange, gray to yellow.

Moisture content tests indicate that the degree of saturation for the gravel samples ranges from 60 to 80 percent. These values represent the high range. A saturation level of 40 percent was determined for one sample.

Three core samples were tested for permeability at vertical and lateral confining pressures representative of field conditions. The test results indicate permeability values of 9.03 X 10E-6, 2.60 X 10E-5, and 7.01 X 10E-5 centimeters per second. Corresponding values are 0.026, 0.074, and 0.15 feet per day, respectively.

The permeability results reflect poor to practically impervious drainage characteristics for the gravel samples. Review of the closure plan reports referenced on page 1 indicates that the amended clay liner for the bottom of the landfill was apparently designed for a permeability value of 10-6 centimeters per second. The low permeability indicated for the gravels will impede downward percolation of water and result in a perched ground water condition if adequate supply is available.

Field examination of cores obtained from the deeper gravel penetrations indicate that some grading to a cleaner matrix is apparent. Preliminary observations indicate that these deeper samples are in a drier condition than those from the top of the unit. Preliminary indications are that the upper 5 to 10 feet of the gravel unit explored is characterized by a low permeability matrix condition.

4.0 GROUND WATER

Access to the lined landfill prism for ground water that could transport contaminants is controlled by the geological formations identified at the RBT Site. Stratigraphic control on water availability for contaminant transport, and migration of the transport waters indicates that the probability of contaminants reaching the regional water supply aquifer in the Troutdale Formation is remote.

4.10 Postulated Intermittent Saturation Zone

The drilling, sampling and testing program completed in August and September for the RBT Site indicates that ground water access to the lined landfill prism, and migration of such water away from the landfill is controlled by the geological formations present at the site. Transmission of ground water in the downward direction at the site is prohibitive based on the fabric and permeability characteristics of the upper clayey silt unit, and the gravels at the top of the Troutdale Formation. The lower, clean sand phase that rests directly on top of the Troutdale gravels is permeable, and will transmit ground water. With aquiclude conditions for the overlying clayey silts, and underlying gravels, ground water transmission is lateral.

The direction of ground water transmission in the clean sand unit will depend on the available pressure head, and the slope of the top of the gravel unit. If the sand phases fill entirely with water, and the water is subject to sufficient head, flow will proceed in the direction of decreasing pressure head gradient. This direction is subject to stratigraphic control by the low permeability clay and gravel units. For the RBT Site, flow directions under full saturation and pressure head conditions, could be south, northeast, or east based on the strata encountered in the borings, and assuming that the permeable sand unit is continuous.

In order for full saturation of the sand phase to occur under pressure conditions, an adequate supply of water is necessary. The principle source for ground water to fill the sand phase is vertical infiltration, lateral flow from an offsite area, or a combination of both.

Vertical infiltration quantities are limited by the permeability of the formations between the sand phase and the ground surface. Review of the USGS Water-Supply Paper No. 1600 and associated fence diagrams of the geologic formations indicates that the Pleistocene alluvial deposits of which the clayey silt unit is a member, is widespread in the general site area. With permeability characteristics demonstrated by the test results, the annual water contribution to the sand unit from the clay unit by vertical infiltration will be low. Though the infiltration volume is likely to be low, the adequacy of this volume of water to fill the sand phase entirely under pressure head conditions is also dependent on the volume and lateral continuity of the sand phase.

The lateral extent of the sand phase and the underlying Troutdale Formation gravels that could transmit and perch ground water, is limited by topographic dissection of the

Troutdale Formation. Erosion and downcutting to result in drainage systems and the north-south trending ridge upon which the site is located, has cut through the top of the Troutdale Formation. This cuts off lateral flows that otherwise might reach the landfill site from large, offsite recharge areas to the east, north and west. Lateral flows on top of the Troutdale Formation gravels could reach the site from the south. However, the flow potential is limited by the narrow distance between Troutdale Formation outcrop exposures in drainages on the east and west sides of the ridge on which the site is located (Figure No. 6).

Based on the topographic conditions and the elevation of the top of the Troutdale Formation, the recharge area for the postulated zone of intermittent saturation is restricted. Therefore, water availability to fully saturate and maintain a significant ground water flow under pressure head conditions that would direct flow without control by the gradient of the Troutdale Formation surface is limited accordingly.

If the sand phase is not fully saturated under pressure head conditions, the flow direction for the water that might be seasonally present will be controlled by the gradient of the contact between the sand phase and the underlying gravel unit. Additional control will result from lateral boundaries of the sand phase, such as the pinchout in clayey silt west of the landfill.

The depths at which the gravel unit was encountered in the 7 borings were converted to elevations for determining the slope direction of the contact between the gravel and overlying permeable sand phase. Contours of the contact approximated on Figure No. 7 indicate that the contact slopes southward beneath the landfill site. Therefore, the direction of lateral, unconfined flow on top of the gravels will be south at the landfill. The geologic cross-section of the site shown on Figure No. 4 also reflects the southward gradient of the gravel-sand contact.

4.11 Regional Troutdale Formation Aquifer

Review of well logs obtained from the Washington State Department of Ecology, and presented in the previously referenced closure reports indicate that the regional water supply aquifer is in sands that comprise the lower Troutdale

Formation. The flow direction for the aquifer is reported to be toward the northwest in the previous closure reports. The depth to the aquifer beneath the RBT Site is approximately 180 feet.

Several well logs in the RBT Site vicinity reflect a cemented gravel sequence in the upper 50 to 100 feet of the Troutdale Formation. The materials below the gravel strata are shown primarily on the logs as clays and sands. A clay strata some 20 feet thick is recorded on the well logs near the site at a depth of approximately 80 to 100 feet. The regional water supply aquifer is shown in sand approximately 60 to 70 feet below the clay strata. Figure No. 8 reflects this condition. Figure No. 9 shows the location of the section and wells.

4.12 Hydraulic Connection, Postulated Zone of Intermittent Saturation and the Regional Water Supply Aquifer

The results of site investigation and review of well logs for the site area indicate that the postulated zone of intermittent saturation and the regional water supply aquifer are remote in terms of separation distance, stratigraphic zones with poor water transmission capabilities, and availability of transport water to make hydraulic connection.

Permeability test results and restricted recharge area for the postulated intermittent saturation zone indicate that seasonal quantities of water, if present at all, are relatively small. Permeability tests also indicate that the gravels at the top of the Troutdale Formation will impede, or stop vertical percolation of intermittent ground waters, resulting in a perched condition and lateral flow.

The clay strata reported on well logs for the site area will impede, or effectively stop downward percolation that might occur, subject to permeability and water availability conditions discussed above.

Based on these conditions, hydraulic connection between the postulated zone of intermittent saturation and the regional water supply aquifer in the lower Troutdale Formation does not appear to exist, or has no practical meaning in terms of contaminant migration from the landfill, to the regional aquifer.

5.0 GROUND WATER MONITORING CONSIDERATIONS

5.10 Objectives of Monitoring System

The principle objective of ground water monitoring is to provide timely detection of water quality changes. Timely detection relates to the proximity of the detection point relative to the source of potential contaminants, ground water flow dispersion away from the source, and flow velocity.

5.11 Relationship Between Monitoring Objectives and Geological Formations at RBT Site

The geological strata encountered at the RBT Site reflect conditions favorable to making timely detection of water quality changes. Specifically, the clayey silt and gravel units beneath the site will confine ground water flows, if they occur, to the permeable sand between the units.

The bottom liner of the landfill, amended with bentonite according to closure reports, is located in the sand unit. It appears that the landfill bottom is in the upper, silty to clayey sand phase. This means if contaminants are present, and if transport water is available, the monitoring zone for timely detection of water quality changes is in the sand unit.

Based on the need for timely detection of water quality changes in the proximity of the possible source, and the availability of geological formations that will contain transport waters to the sand phase beneath the landfill, monitoring provisions should utilize the advantages presented by the sand strata.

6.0 IMPLEMENTATION OF GROUND WATER MONITORING AT THE RBT SITE

6.10 Confirmation of Transport Water Availability

To develop an adequate monitoring program for the RBT Site, a logical first step is to confirm the existence of the postulated intermittent saturation zone, and the availability of transport water in a seasonal, "uppermost aquifer".

The ground water monitoring system for the RBT Site is implemented since the 7 borings drilled on the site are equipped with provisions to allow monitoring of the sand phase, and sampling if seasonal ground water conditions develop. Each boring contains 2 inch PVC threaded tubing and slotted screen sections in sand-packed intake areas for monitoring purposes. The borehole interval between the top of the sand pack and the ground surface was filled and sealed with bentonite clay.

These sampling wells will help identify if the postulated intermittent saturation on top of the gravel unit occurs, help identify the quantity of water available for contaminant transport, help identify the time duration of the saturation condition, and will help identify the direction of flow for the transport water. This system will monitor the sand unit through the upcoming wet season. Accordingly, the question of water availability for transporting contaminants, and the questions about the presence of a seasonal "upper aquifer" can be answered. The best monitoring system for the site can then be determined and implemented.

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.10 The sequence of stratigraphic units between the ground surface and the gravel unit of the Troutdale Formation at the RBT Site will result in perched ground water in sand on top of the gravel unit. If water is perched, flow will be lateral toward the south beneath the landfill.

7.11 Hydraulic connection between the postulated zone of intermittent saturation and the regional water supply aquifer in the Troutdale Formation is a remote possibility. If intermittent saturation on top of the gravel unit occurs, perching and the presence of a clay strata reported on well logs at depth below the gravel unit, combined with the probable limited water supply of an intermittent flow will diminish the possibility of hydraulic connection and contaminant migration to the regional aquifer.

7.12 Geological stratification and associated controls on ground water flow, if it occurs at the landfill bottom, supports use of a shallow monitoring system in the permeable sand unit between the overlying clay and underlying gravel units. Monitoring of this sand through the upcoming 1987-88 wet season will provide the information necessary to finish characterization of the upper potential saturation zone that may exist seasonally. This initial phase of RBT Site monitoring will provide the basis for determining the need for additional monitoring provisions.

7.13 The stratigraphic conditions and test results for the formations at and just below the landfill, and review of the deeper geological conditions presented in published documents and well logs, indicates that the regional water supply aquifer is stratigraphically and hydraulically remote from the landfill. Additional deep monitoring wells appear at this time to offer no value to a monitoring system for the RBT Site.

If ground water is present at the landfill zone, and contaminants are present that could be transported, the most timely and useful water quality detection system utilizes sampling wells tapping the permeable sand strata between the landfill bottom liner and the top of the gravel unit.

7.14 The 7 borings drilled on the site and equipped with sampling wells are adequate to monitor ground water conditions during the upcoming 1987-88 wet season, and determine if an intermittent saturation zone, or "upper seasonal aquifer" develops on top of the Troutdale Formation gravel unit.

7.15 Monitoring through the upcoming 1987-88 wet season will characterize the landfill zone in terms of water availability to transport contaminants, if they are present. Water availability will help identify the type and extent of monitoring system that best meets site and regulatory needs.

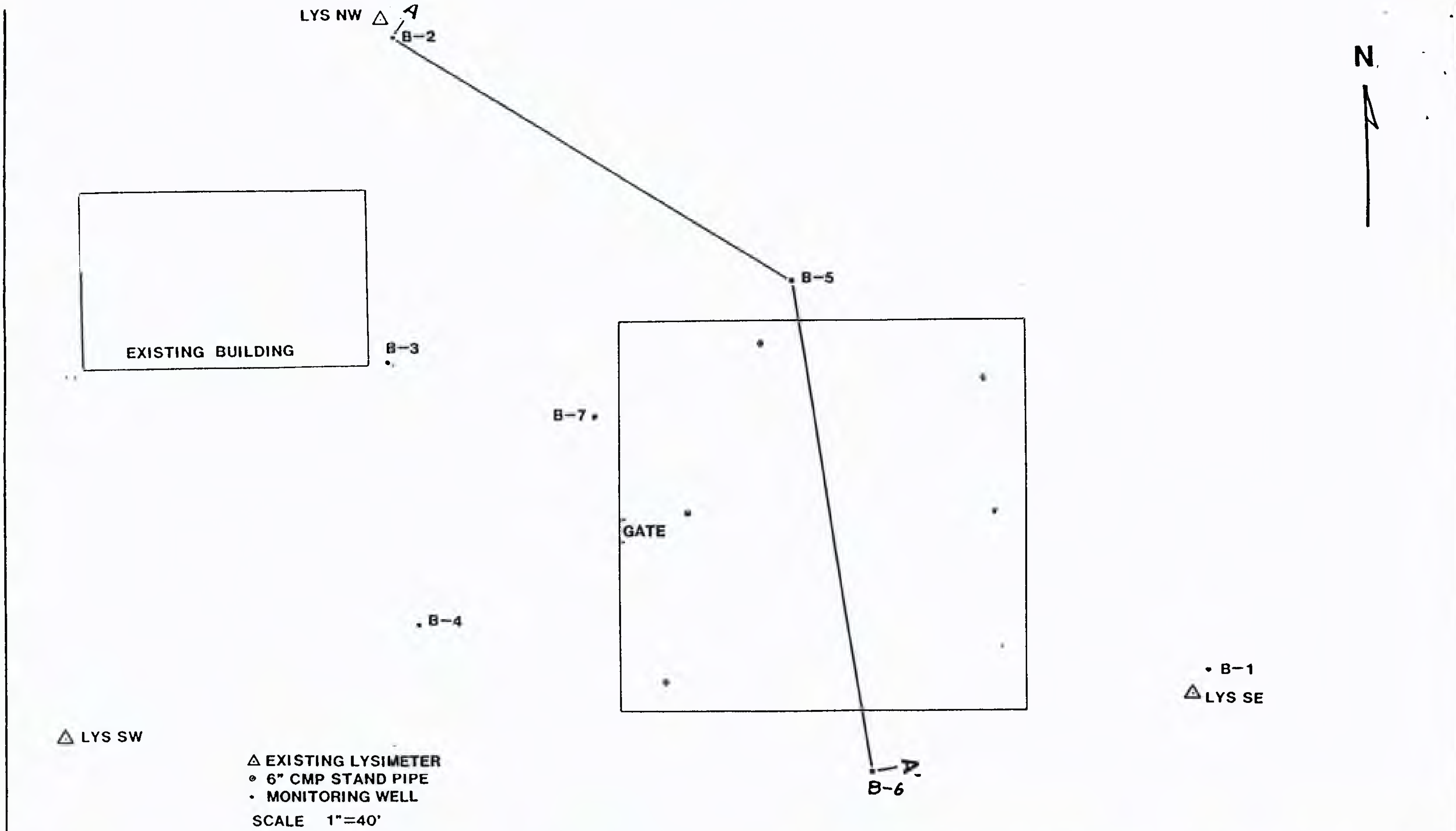
7.16 It is recommended that the 7 wells are monitored through the upcoming 1987-88 wet season to determine if a seasonal upper "aquifer" develops, and to determine baseline water quality for samples obtained from the wells. Monitoring information should be collected that indicates first arrival of water, elevation levels in the wells, and duration of the saturation condition.

7.17 It is recommended that the results of the above initial monitoring of the site be used to determine the monitoring system that best meets site and regulatory needs. Monitoring results and associated conclusions should be documented and presented to the EPA within the next 10 months. This period includes potential saturation and drainage periods for the upcoming wet season.

This concludes the progress report of site characterization and monitoring for the RBT Site. Additional information will be presented to PWTC and the EPA as it is developed over the next 10 month period to supplement this report, and identify the monitoring system that best meets site and regulatory needs.

SOURCE: RIDGEFIELD QUADRANGLE, WA
7.5' SERIES TOPOGRAPHIC MAP
U.S. GEOLOGICAL SURVEY

DESIGNED BY	D. PETTIT	PROJECT NO.	213G131	DATE	DAVID J. NEWTON ASSOCIATES, INC.	VICINITY MAP SHOWING AREA DRAINAGE, CULTURE, AND TOPOGRAPHY	FIGURE
DRAWN BY	D. PETTIT	REVISED		/22/87			1
APPROVED BY	D. NEWTON	REVISED					



DESIGNED BY	D. PETTIT	PROJECT NO.	213G131	DATE	DAVID J. NEWTON ASSOCIATES, INC.	MONITORING WELL LOCATION, SITE MAP, AND CROSS-SECTION A-A' LOCATION	FIGURE
DRAWN BY	D. PETTIT	REVISED		9/22 /87			2
APPROVED BY	D. NEWTON	REVISED					

ATTERBERG LIMITS TEST DATA

FROM CLAY UNIT IN BORING B-1

JOB NO. 16170-001-041

CLIENT/OWNER DAVID NEWTON

LOCATION

FIELD CLASSIFICATION CLSI

LABORATORY CLASSIFICATION CL

BORING 1 SAMPLE 5A DEPTH 15'9" 16'3"

FIELD DENSITY BY AM 09.08.87

DETERMINATION	1	2
NUMBER OF RINGS	6	
WT OF RINGS + WET SOIL	1163.1	
WT OF RINGS	270.0	—
WT OF WET SOIL	893.1	
FIELD DENSITY	123.84	
DRY DENSITY	99.15	

THIS IS AN 1/8-INCH THREAD [redacted]

DETERMINATION	1	2
DISH	61	
WT OF DISH + WET SOIL	193.8	
WT OF DISH + DRY SOIL	161.9	—
WT OF MOISTURE	31.9	
WT OF DISH	33.8	—
WT OF DRY SOIL	128.1	
FIELD MOISTURE CONTENT	24.9	

PLASTIC LIMIT BY AM 09.09.87

DETERMINATION	1	2	3	4	5	6
DISH	8	10	VII			
WT OF DISH + WET SOIL	24.71	24.26	22.35			
WT OF DISH + DRY SOIL	22.22	21.95	20.57			
WT OF MOISTURE	2.49	2.31	1.78			
WT OF DISH	12.80	12.88	12.57			
WT OF DRY SOIL	9.42	9.07	8.00			
MOISTURE CONTENT	26	25	22			

SATURATED MOISTURE CONTENT @ S.G = 2.70 IS 26%

DEGREE OF SATURATION IS ~ 96%

LIQUID LIMIT

DETERMINATION	1	2	3	4	5	6
DISH	F	XII	5	IV		
NUMBER OF BLOWS	43	38	21	15		
WT OF DISH + WET SOIL	40.72	31.27	32.82	28.59		
WT OF DISH + DRY SOIL	33.76	26.18	27.06	23.84	—	—
WT OF MOISTURE	6.96	5.09	5.76	4.75		
WT OF DISH	13.17	12.95	12.82	12.64	—	—
WT OF DRY SOIL	20.59	13.23	14.24	11.20		
MOISTURE CONTENT	34	38	40	42		

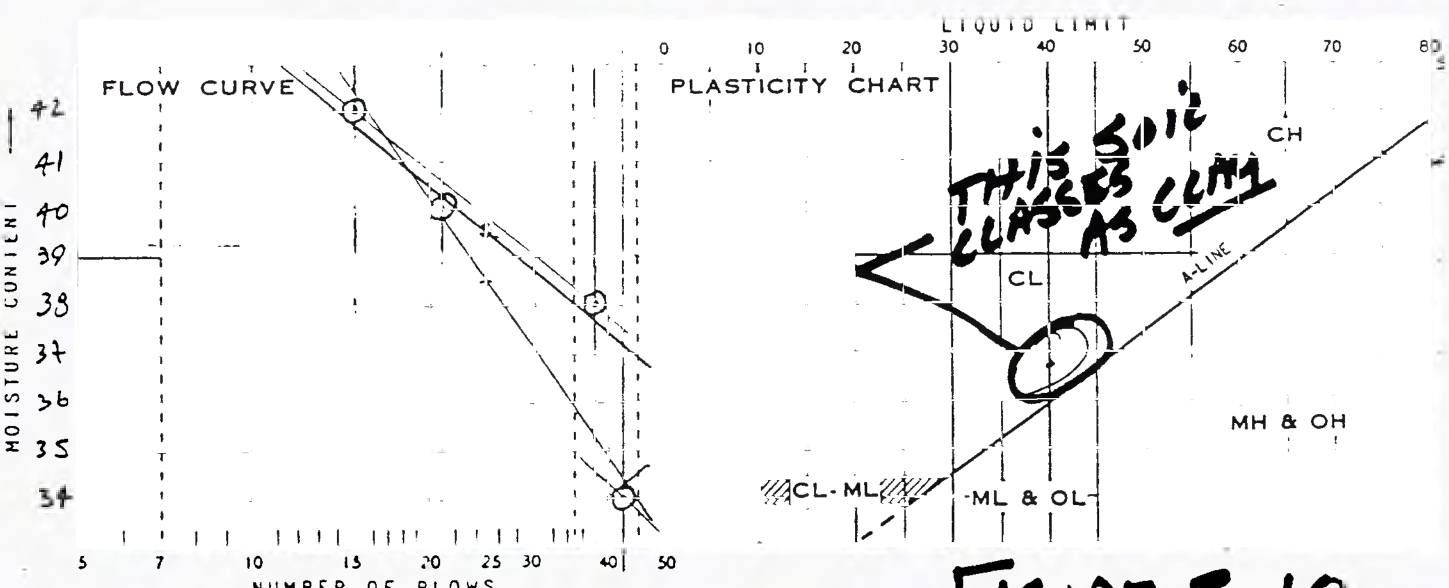


FIGURE 3.10

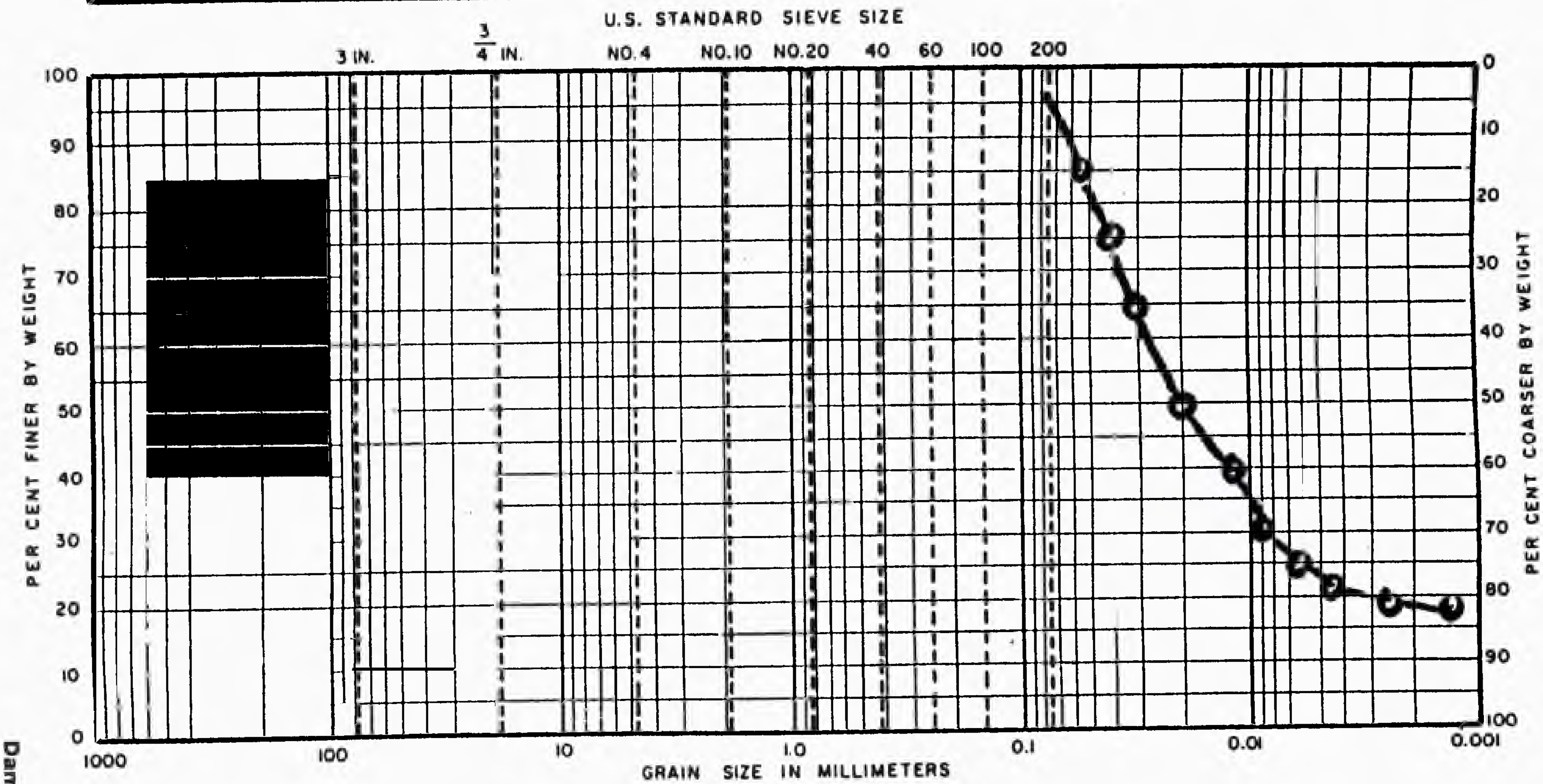
SUMMARY

DRY DENSITY	MOISTURE CONTENT	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	IDENTIFICATION	
99.15	24.9	40	22	18	CL	CL

757-8

FROM CLAY UNIT IN BORING B-1

BORING	DEPTH	ELEV.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL CLASSIFICATION	KEY
1	15'9"		3-5A				CLAY, SILTY	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Dames & Moore

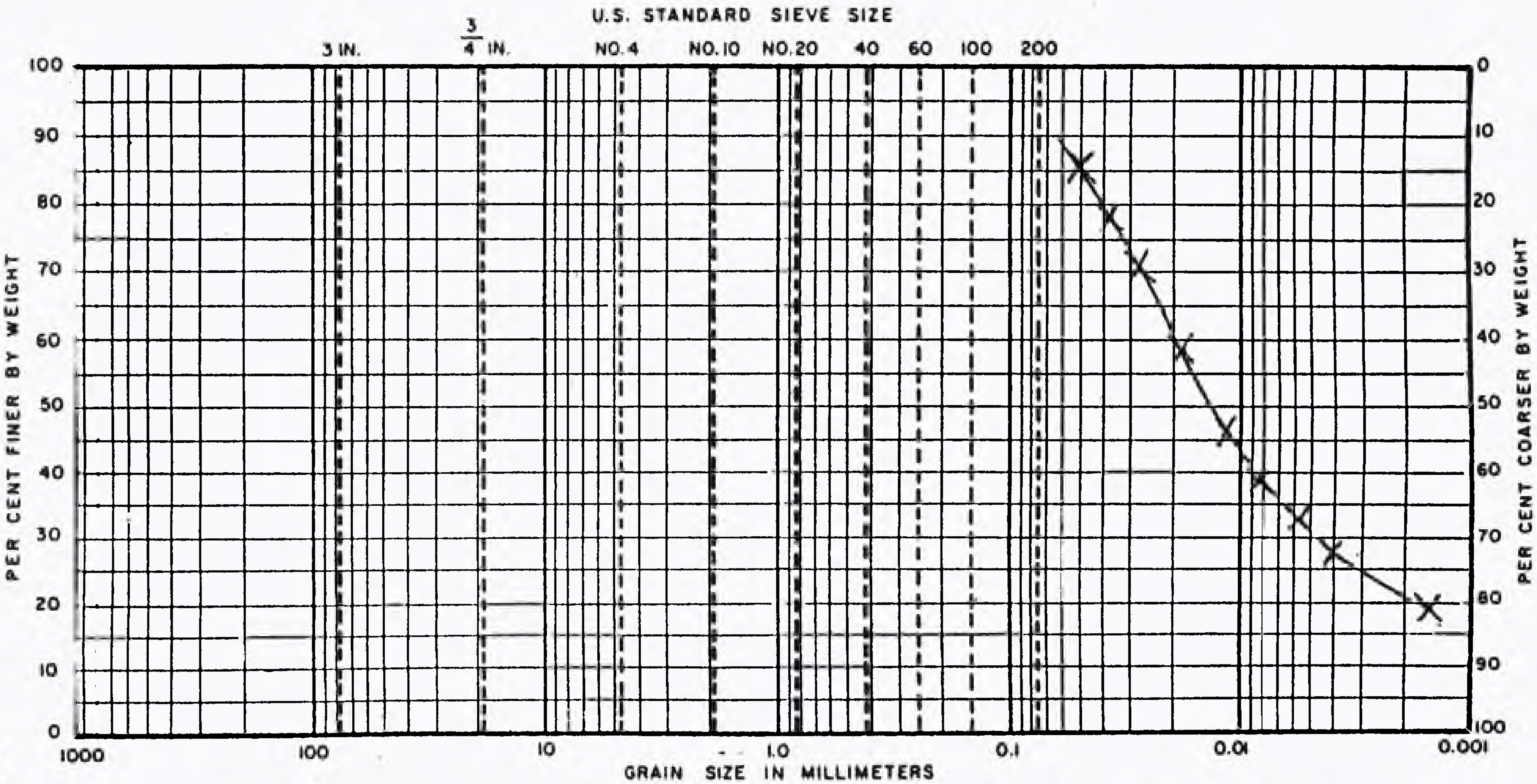
GRAIN-SIZE DISTRIBUTION
(UNIFIED SOIL CLASSIFICATION SYSTEM)

FIGURE 3.11

57.8

16170-001-041 FROM "CLAYEY SILT" IN BORING B-1

BORING	DEPTH	ELEV.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL CLASSIFICATION	KEY
1	27		9			CL	SILTY CLAY	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

GRAIN-SIZE DISTRIBUTION
(UNIFIED SOIL CLASSIFICATION SYSTEM)

FIGURE 3.12

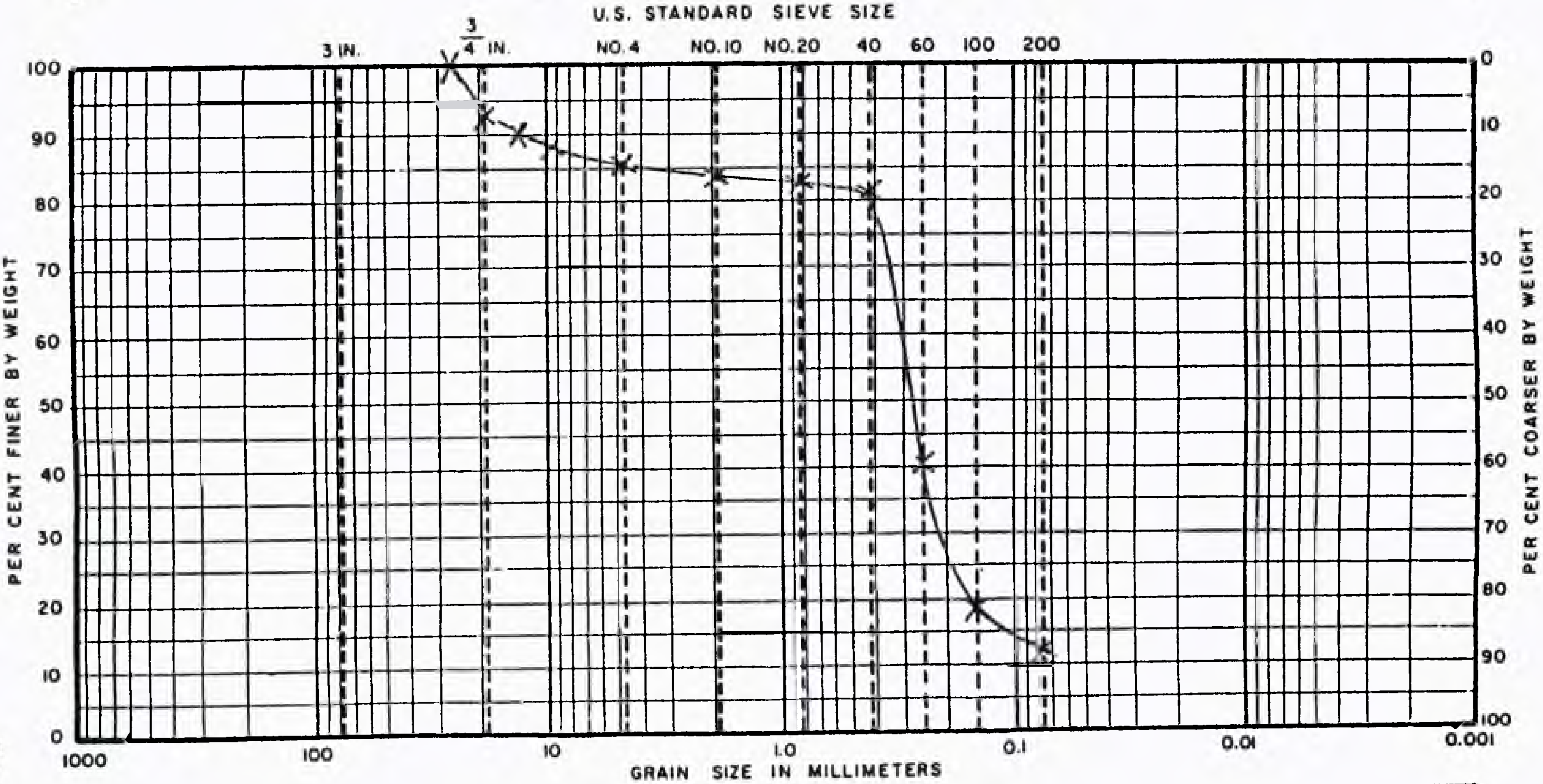
DAMES & MOORE

157.8

16170-001-41

FROM TOP OF "GRAVELS" IN BORING B-1 — UNDER THE SAND PHASE

BORING	DEPTH	ELEV.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL CLASSIFICATION	KEY
1	51		19A			SM	GRAVELLY SILTY SAND	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

GRAIN-SIZE DISTRIBUTION
(UNIFIED SOIL CLASSIFICATION SYSTEM)

FIGURE 3.13

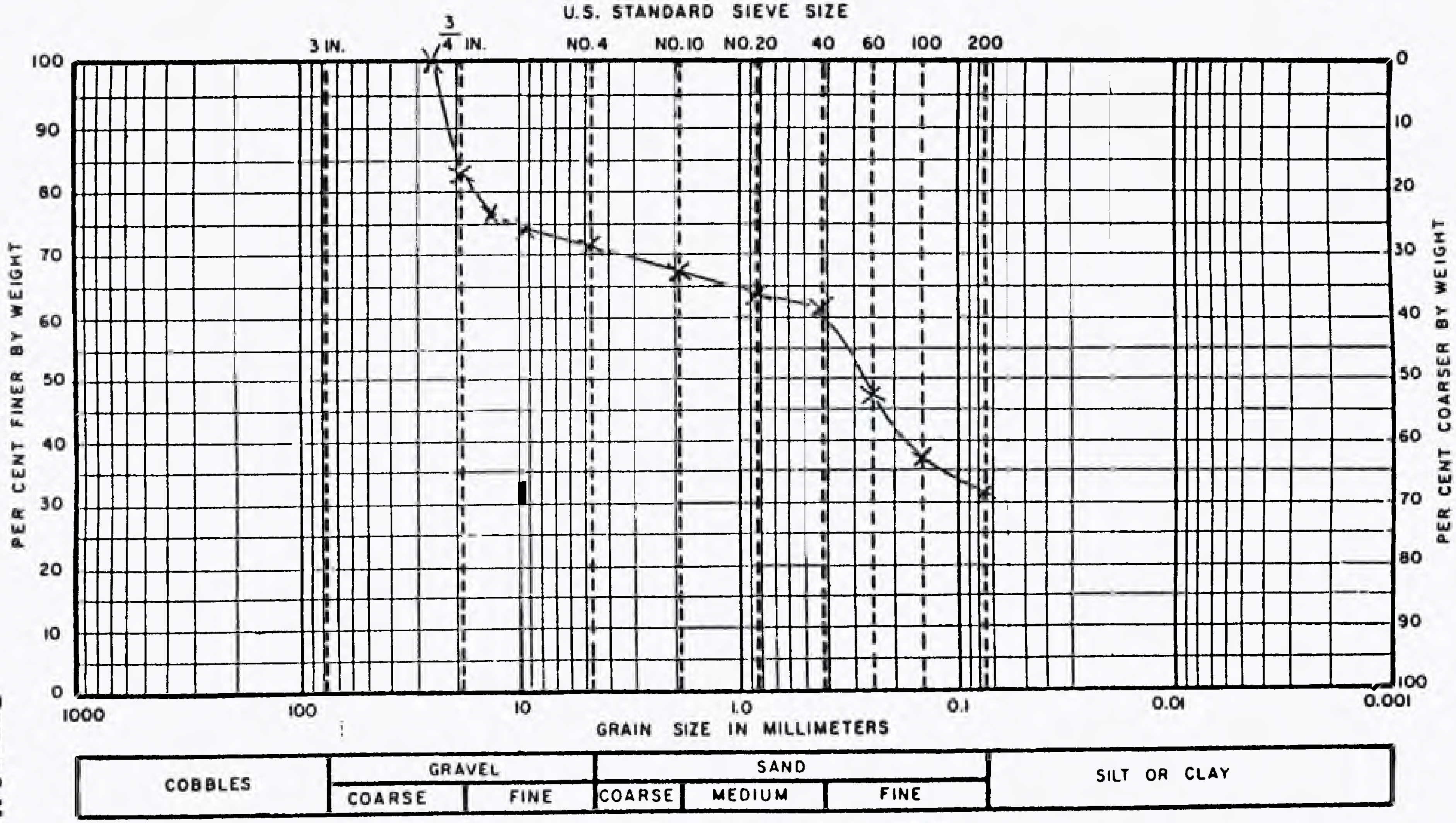
Dames & Moore

757.8

16170-001-041

FROM "GRAVELS" BENEATH CLAY UNIT IN BORING B-2

BORING	DEPTH	ELEV.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL CLASSIFICATION	KEY
2	25 1/4		9			SM	GRAVELLY SILTY SAND	



Dames & Moore

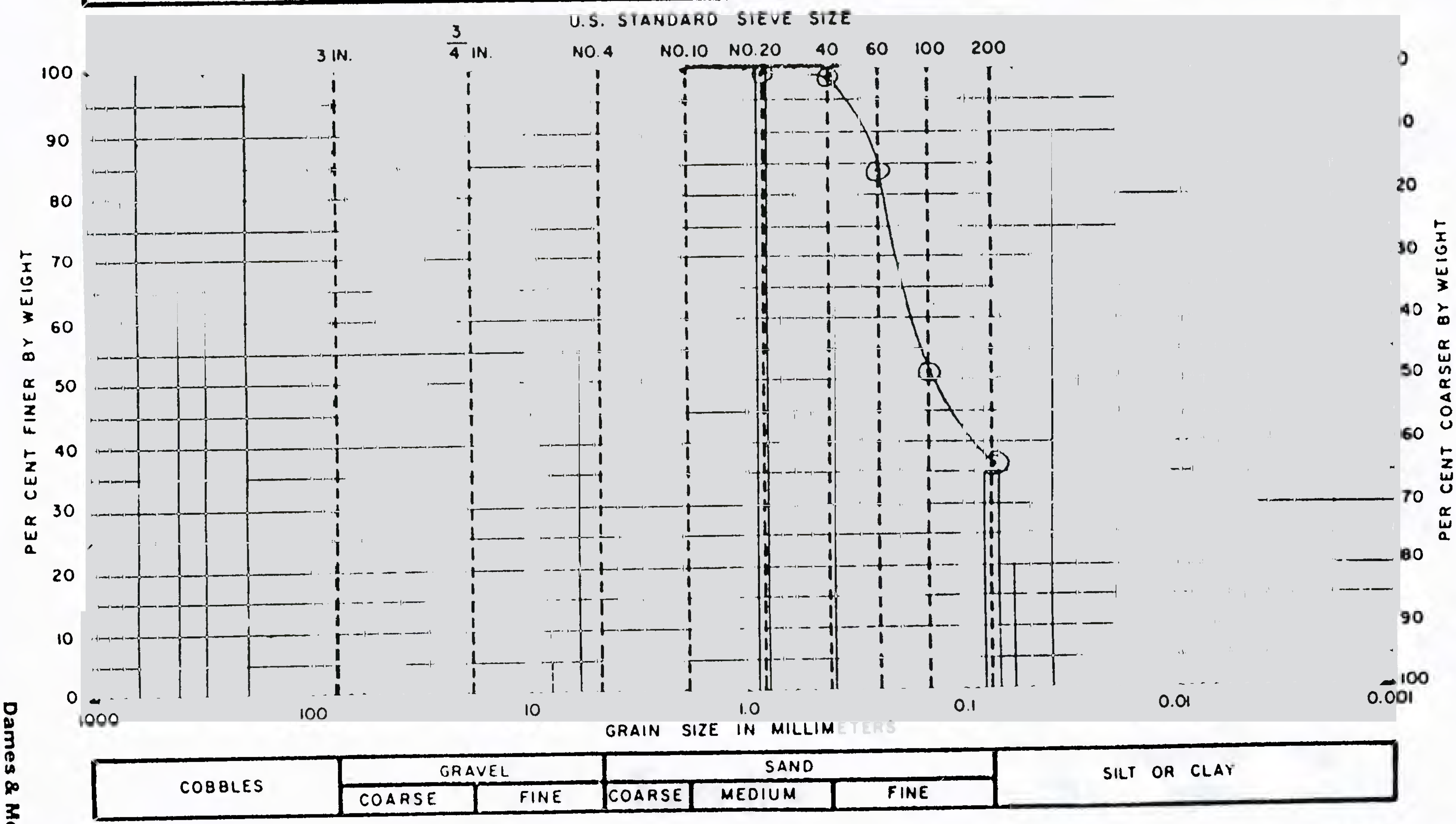
GRAIN-SIZE DISTRIBUTION
(UNIFIED SOIL CLASSIFICATION SYSTEM)

FIGURE 3.14

757.8

FROM MICACEOUS "SILTY SAND" UPPER SAND PHASE, BORING B-5

BORING	DEPTH	ELEV.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL CLASSIFICATION	KEY
5	15'		6A				VERY SILTY SAND	



Dames & Moore

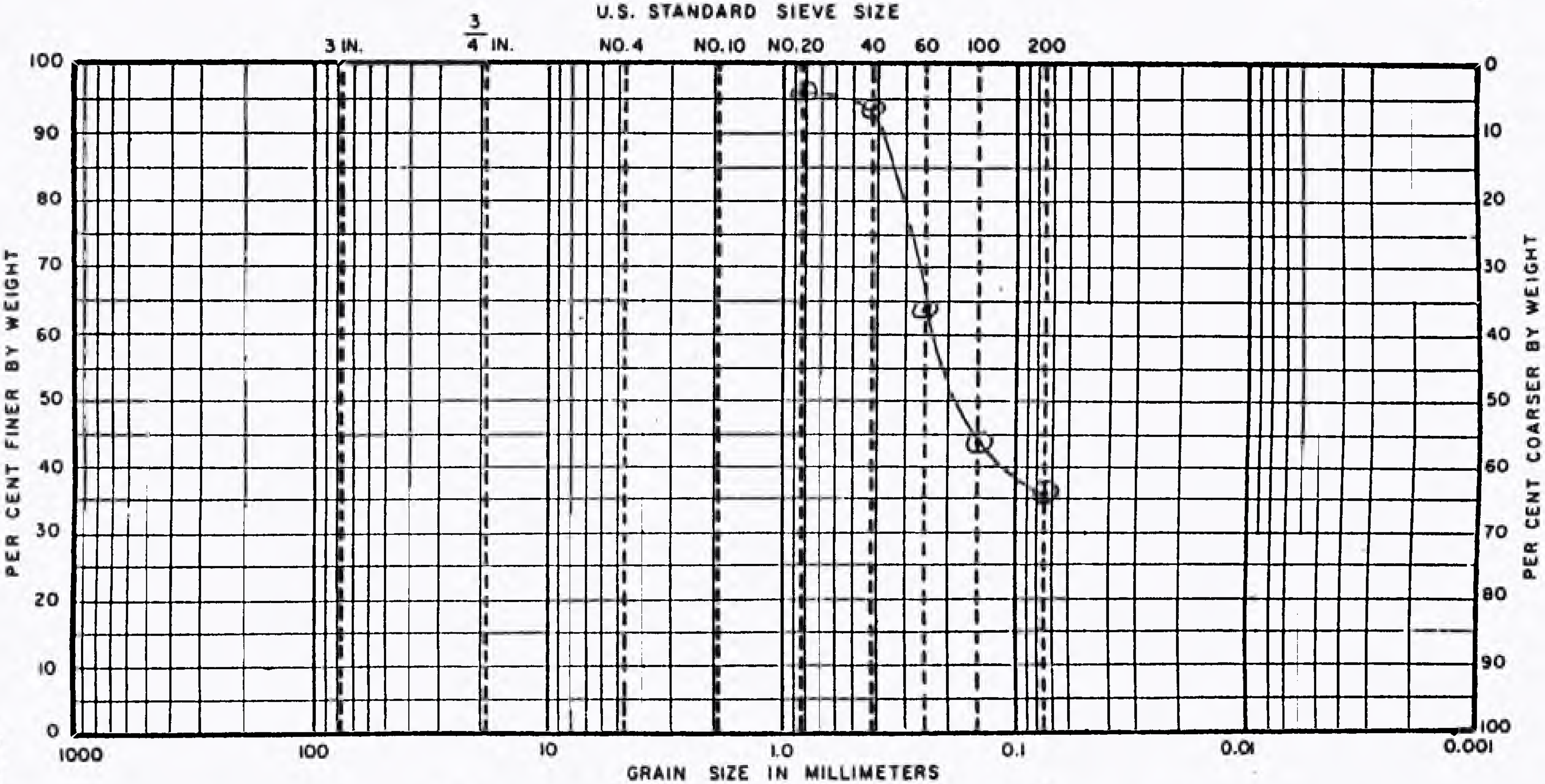
GRAIN-SIZE DISTRIBUTION
(UNIFIED SOIL CLASSIFICATION SYSTEM)

FIGURE 3.15

757.8

FROM BOTT. OF LOWER SAND PH. E
AT TOP OF "G. AN 65", BORING B-5

BORING	DEPTH	ELEV.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL CLASSIFICATION	KEY
5	23'		9A					



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Dames & Moore

GRAIN-SIZE DISTRIBUTION
(UNIFIED SOIL CLASSIFICATION SYSTEM)

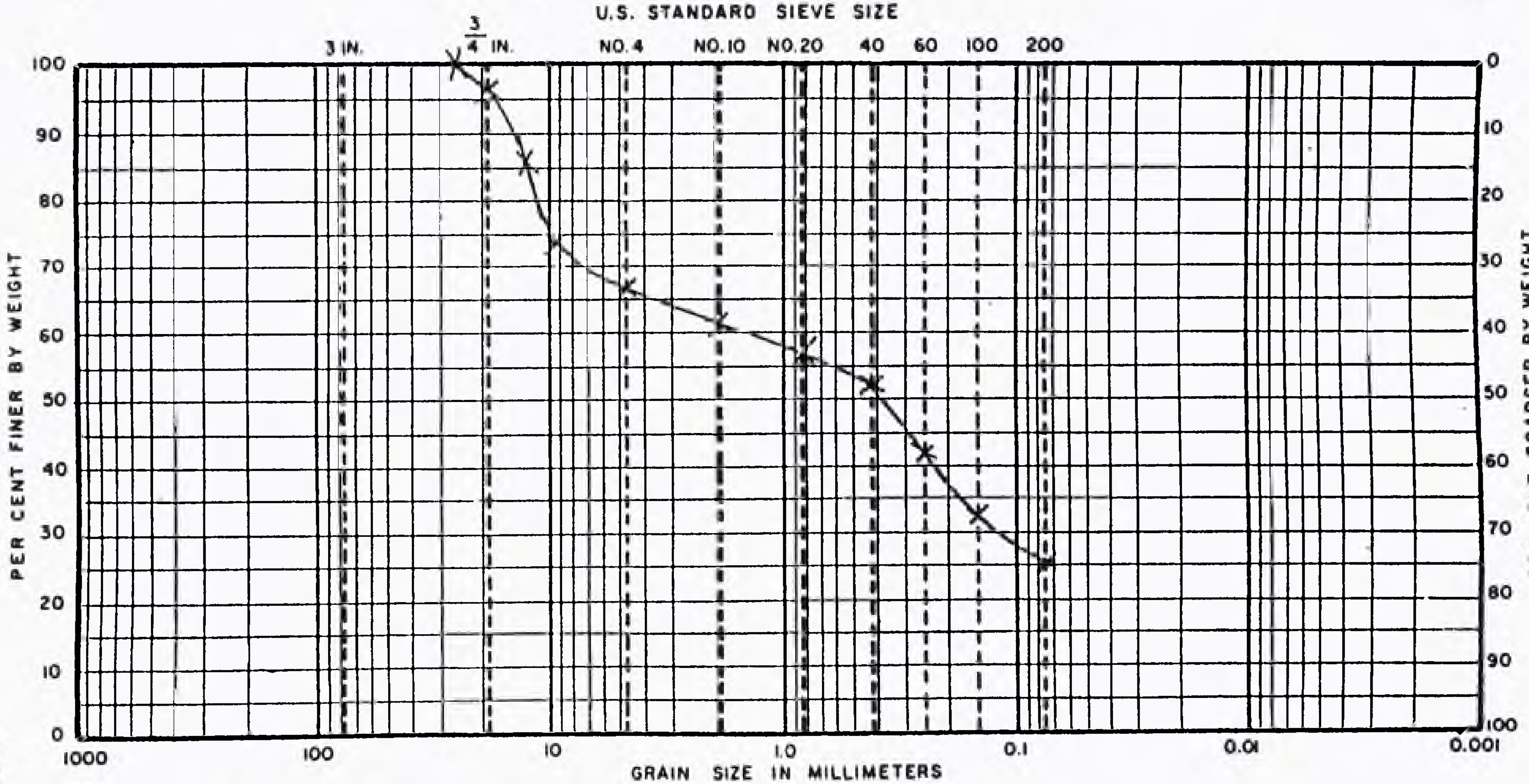
FIGURE 3.16

57.8

DJN ASSOC
16170-001-041

FROM "GRAV-LS" UNDER -AND IN BO-ING B-5

BORING	DEPTH	ELEV.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL CLASSIFICATION	KEY
5	26		10A			SM	GRAVELLY SILTY SAND	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

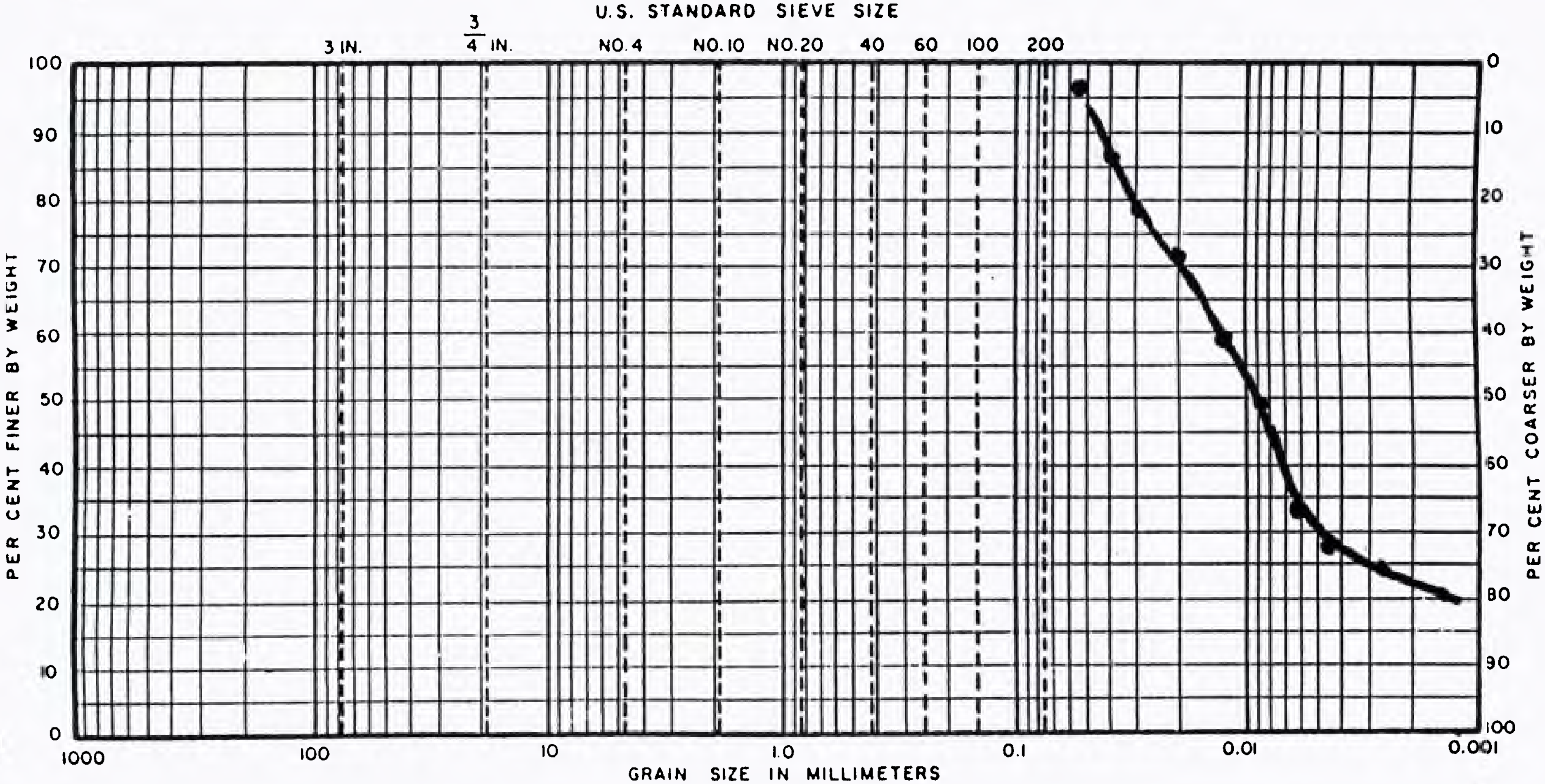
GRAIN-SIZE DISTRIBUTION
(UNIFIED SOIL CLASSIFICATION SYSTEM)

FIGURE 3.17

'57.8

TE N CLAY UNIT IN BORING B-6

BORING	DEPTH	ELEV.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL CLASSIFICATION	KEY
6	10'3"		S-3A				CLAY, SILTY	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

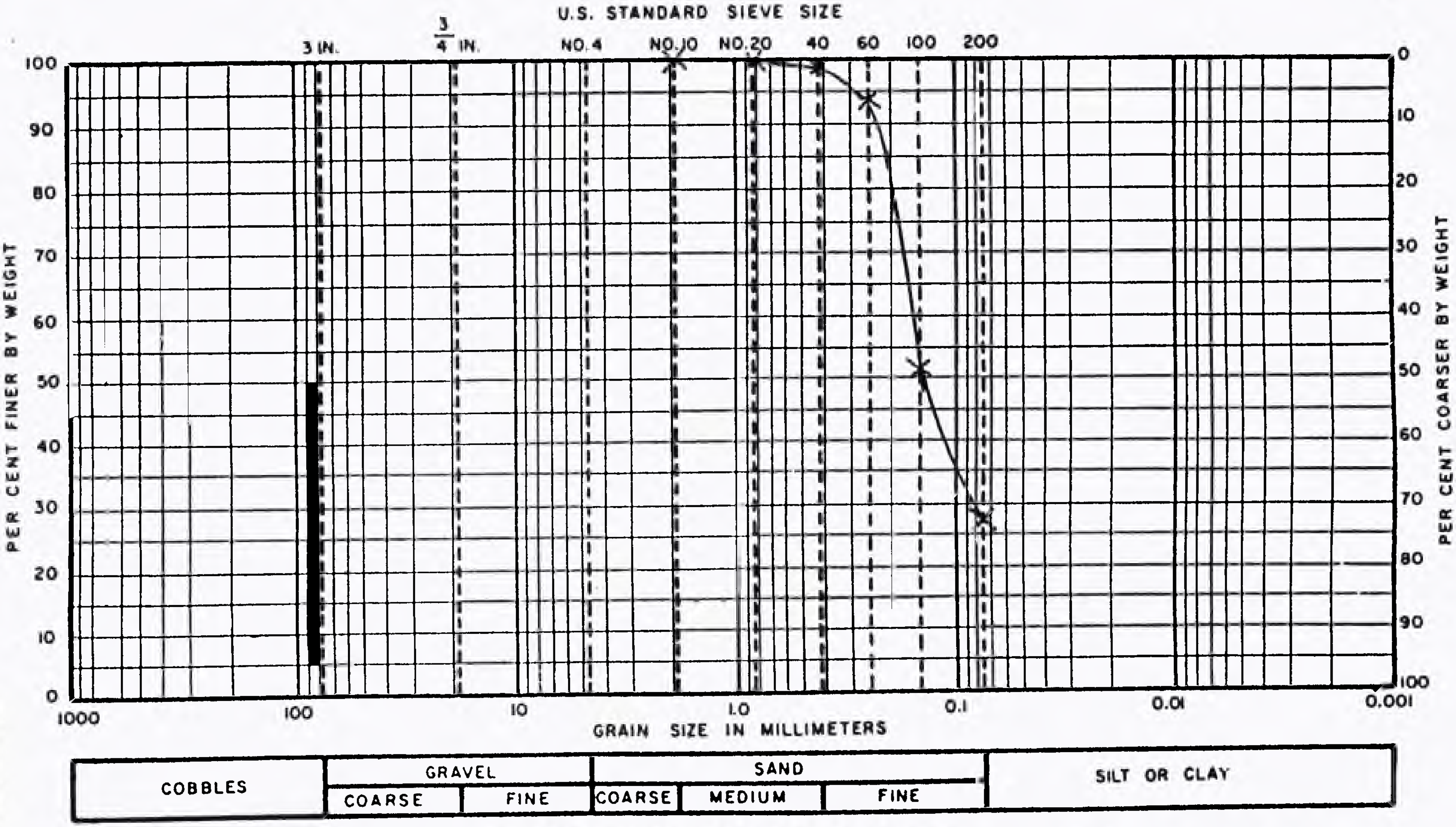
Dames & Moore

GRAIN-SIZE DISTRIBUTION
(UNIFIED SOIL CLASSIFICATION SYSTEM)

FIGURE 3.18

16170-001-41 FROM MICACEOUS SILTY SAND, UPPER SAND PHASE IN BORING B-6

BORING	DEPTH	ELEV.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL CLASSIFICATION	KEY
6	28½		10 B			SM	SILTY SAND	



GRAIN-SIZE DISTRIBUTION
(UNIFIED SOIL CLASSIFICATION SYSTEM)

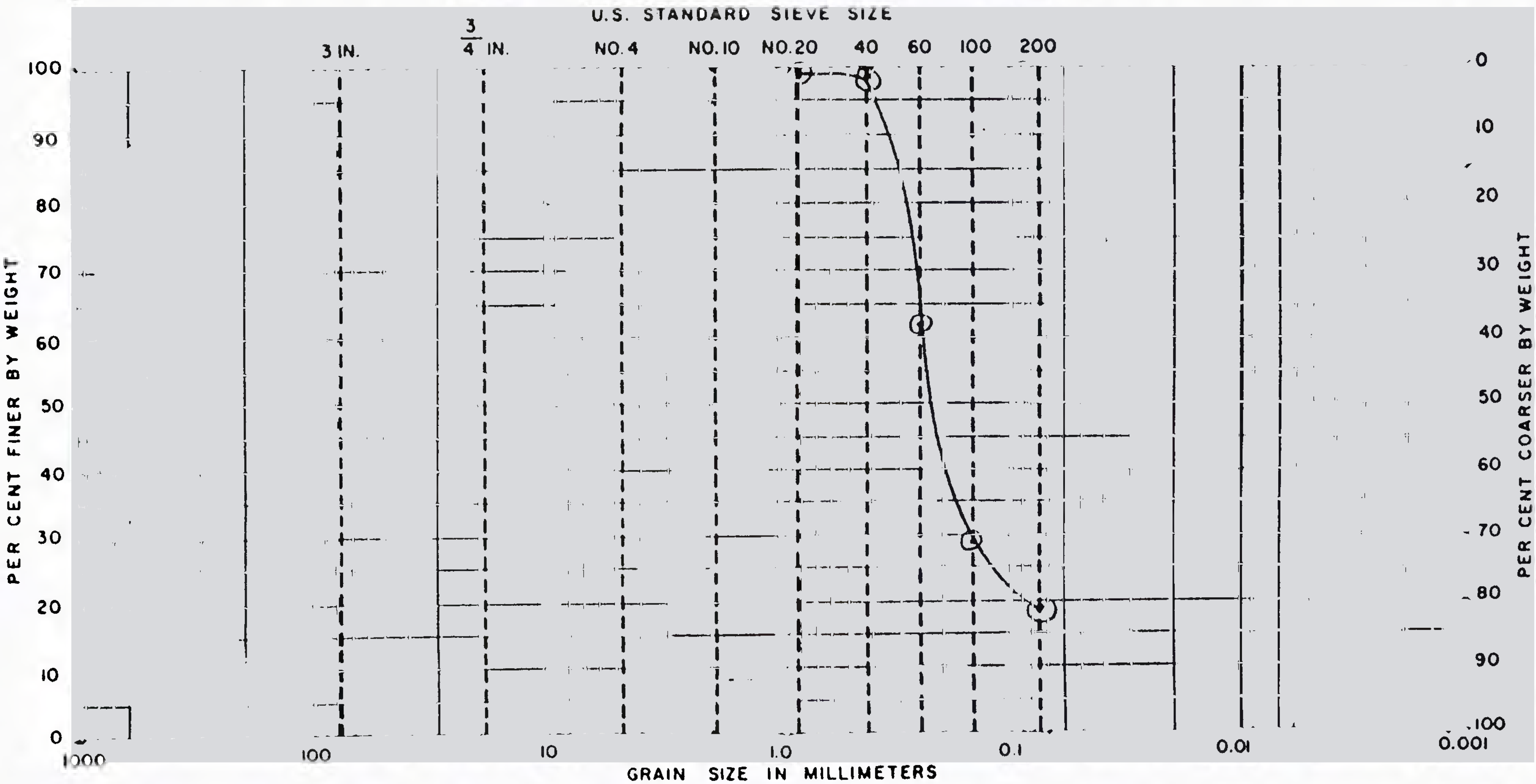
FIGURE 3.19

DAMES & MOORE

57.8

FROM TOP OF CL... SAND; LOWER ... ID
PHASE, BORING B-6

BORING	DEPTH	ELEV.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL CLASSIFICATION	KEY
6	33′		12A				SILTY SAND	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Dames & Moore

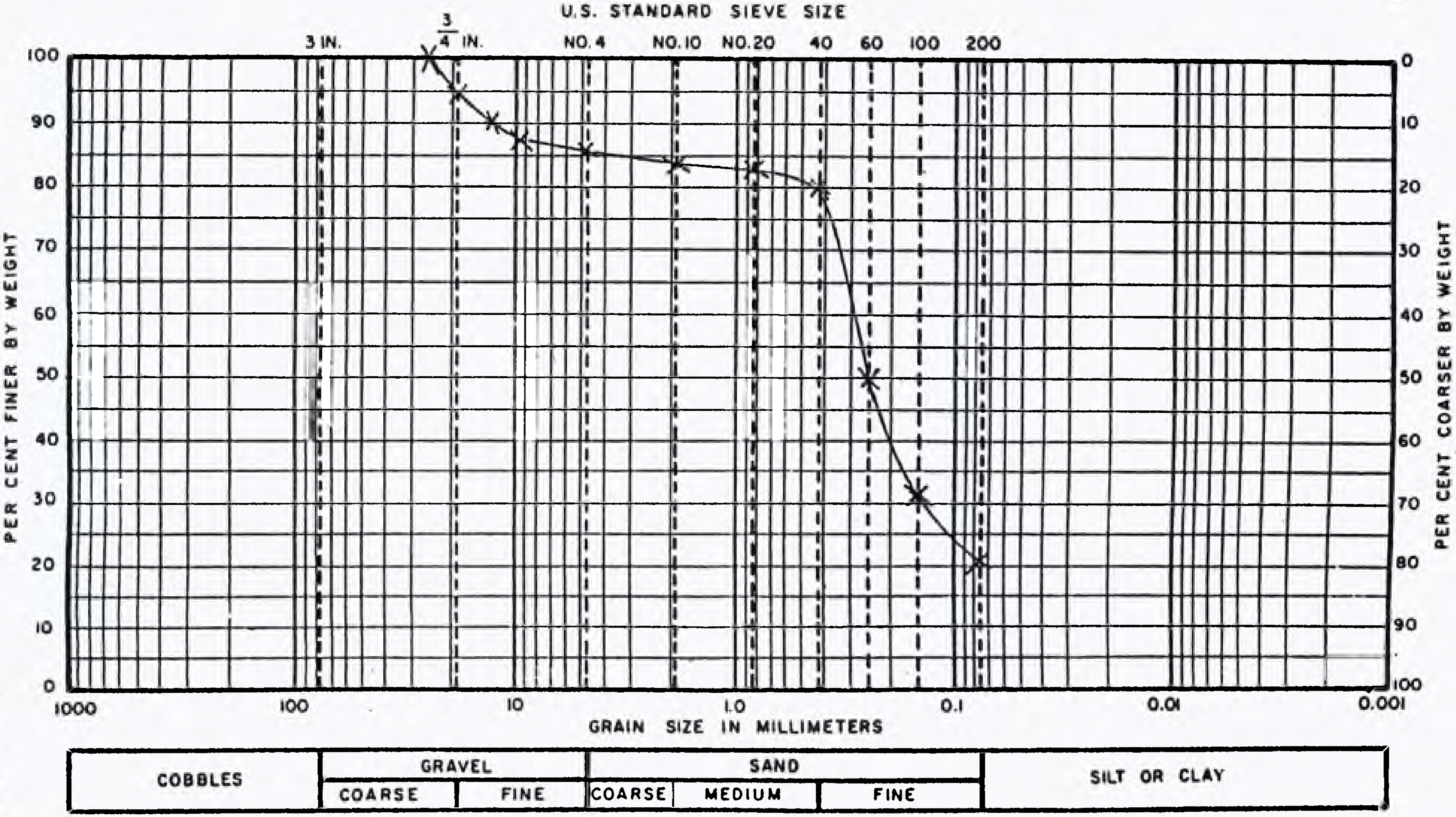
GRAIN-SIZE DISTRIBUTION
(UNIFIED SOIL CLASSIFICATION SYSTEM)

FIGURE 3.20

37-8

16170-001-041 FROM GRAVELS UNDER SAND IN BORING B-6

BORING	DEPTH	ELEV.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL CLASSIFICATION	KEY
6	43¼		16A			SM	GRAVELLY SILTY SAND	



GRAIN-SIZE DISTRIBUTION
(UNIFIED SOIL CLASSIFICATION SYSTEM)

FIGURE 3.21

DAMES & MOORE

MLS

PERMEABILITY - CONSTANT HEAD

JOB D J N Assoc JOB NO 16170-001-41 LOC. ______ $T = 21\frac{1}{2}$ °c

BORING 1 SAMPLE 9 DEPTH 27 FT.

(L) = 4.925 IN. (A) = 6.459 IN^2 $\mu_T / \mu_{20°c}$ = 9.37/10.09 $K_{20°c} = \frac{QL}{tHA} \times \frac{\mu_T}{\mu_{20°c}}$

$\bar{\sigma}_3$ = 2100 psf

DATE	CELL PRESS. (PSI)	BACK PRESS. — BASE (PSI)	BACK PRESS — CAP₂ (PSI)	DIFF HEIGHT OF H_2O COLUMN (IN)	(H) HEAD (PSI)	(H) HEAD FT ~~(IN)~~	TIME	(t) ELAPSED TIME (MIN)	INT. BURET READING (C.C.)	(Q) Δ C.C.	$K_{20°c}$ cm/sec	$K_{20°c}$ in/min
9/23	108.6	94	92.5	0	0							
		96	90.5	0	4	9.24	0932	0	23.22	0		
							0958	26	20.72	2.5	1.587×10^{-6}	3.748×10^{-5}
							10:15	43	19.20	4.02	1.543×10^{-6}	3.644×10^{-5}
		98	88.5	0	8	18.48	10:17	0	24.49	0		
							10:22	5	23.55	0.94	1.551×10^{-6}	3.664×10^{-5}
							10:36	19	20.92	3.57	1.550×10^{-6}	3.662×10^{-5}
							10:46	29	19.16	5.33	1.516×10^{-6}	3.582×10^{-5}
										AVERAGE	1.549×10^{-6}	3.660×10^{-5}

FROM CLAY UNIT ABOVE SAND PHASE IN BORING B-1

FIGURE 3.22

PERMEABILITY - CONSTANT HEAD

$T = 21\frac{1}{2}$ °C

JOB DJN Assoc JOB NO 16170-001-41 LOC. ______

BORING 1 SAMPLE 19A DEPTH 51 FT.

(L) = 5.453 IN. (A) = 4.520 IN² $\mu_T/\mu_{20°C}$ = 9.73/10.09 $K_{20°C} = \frac{QL}{tHA} \times \frac{\mu_T}{\mu_{20°C}}$

$\bar{\sigma}_3$ = 2600 psf

DATE	CELL PRESS. (PSI)	BACK PRESS. — BASE (PSI)	BACK PRESS — CAP2 (PSI)	DIFF HEIGHT OF H_2O COLUMN (IN)	(H) HEAD (PSI)	(H) HEAD FT. ~~(IN)~~	TIME	(t) ELAPSED TIME (MIN)	INT. BURET READING (C.C.)	(Q) Δ C.C.	$K_{20°C}$ cm/sec	$K_{20°C}$ in/min
9/23	100	81.9	82.0	0	0							
		82.9	81.0	0	2	4.62	9:42 9:45	0 3	18.48 14.3	0 4.18	7.555×10^{-5}	1.785×10^{-3}
							9:48	6	10.51	7.97	7.203×10^{-5}	1.701×10^{-3}
							9:50	8	8.14	10.34	7.008×10^{-5}	1.655×10^{-3}
		83.9	80.0	0	4	9.24	09:54	0	18.4	0		
							55	1	15.8	2.6	7.049×10^{-5}	1.665×10^{-3}
							56	2	13.3	5.1	6.913×10^{-5}	1.633×10^{-3}
							57	3	10.8	7.6	6.868×10^{-5}	1.622×10^{-3}
										AVERAGE	7.099×10^{-5}	1.677×10^{-3}

FROM "GRAVELS" BENEATH SAND IN BORING B-1

FIGURE 3.23

PERMEABILITY - CONSTANT HEAD

JOB DJN Assoc. JOB NO 16170-001-041 LOC. ______ T = 21.5 °C

BORING 6 SAMPLE 16A DEPTH 43 1/2 FT.

(L) = 5.734 IN. (A) = 4.553 IN² $\mu_T / \mu_{20°C}$ = 9.73/10.09 $K_{20°C} = \frac{QL}{tHA} \times \frac{\mu_T}{\mu_{20°C}}$

$\bar{\sigma}_3$ = 2200 psf

DATE	CELL PRESS. (PSI)	BACK PRESS. — BASE (PSI)	BACK PRESS — CAP2 (PSI)	DIFF HEIGHT OF H_2O COLUMN (IN)	(H) HEAD (PSI)	(H) HEAD FT. ~~IN~~	TIME	(t) ELAPSED TIME (MIN)	INT. BURET READING (C.C.)	(Q) Δ C.C.	$K_{20°C}$ cm/sec	$K_{20°C}$ in/min
9/23	100	84.7	84.8	0	0	0						
		85.7	83.8	0	2	4.62	09:38 09:47	0 9	21.0 16.31	0 4.69	2.950×10^{-5}	6.968×10^{-4}
							0958½	20.5	11.10	9.9	2.734×10^{-5}	6.457×10^{-4}
							10 04	26	8.78	12.22	2.660×10^{-5}	6.284×10^{-4}
		86.7	82.8	0	4	9.24	10:07	0	18.00	0		
							10:09	2	16.25	1.75	2.476×10^{-5}	5.850×10^{-4}
							10 13½	6.5	12.45	5.55	2.417×10^{-5}	5.708×10^{-4}
							10:18	11	8.86	9.14	2.352×10^{-5}	5.555×10^{-4}
										AVERAGE	2.598×10^{-5}	6.137×10^{-4}

FROM "GRAVELS" BENEATH SANDS IN BORING B-6 FIGURE 3.25

"GRAVEL", B-5

SILTY SAND, "UPPER SAND PHASE" B-6

MOISTURE AND DENSITY DETERMINATIONS

DAMES & MOORE

CLIENT DJN ASSOC.

LOCATION

JOB NO. 16170-001-04

PAGE OF

SAMPLE & SOIL TYPE	BORING	B-5	B-6
	SAMPLE NO.	S 10A	S-10B
	SAMPLE DEPTH	25'7½"–26'3½"	28'3"–28'9"
	DATE SAMPLED BY		
	DATE TESTED BY		
	SOIL TYPE		
	LABORATORY IDENTIFICATION	DARK BROWN SILTSTONE CALCAREOUS	BROWN MICACEOUS SILTY SAND
DENSITY	NO. OF RINGS	4	6
	WT. OF WET SOIL & RINGS		1003.7
	WT. OF RINGS		226.8
	WT. OF WET SOIL	550	776.9
	WET DENSITY (LBS./CU.FT.)	114.3	107.6
	DRY DENSITY (LBS./CU.FT.)	90.7	88.8
MOISTURE CONTENT	DISH NO.	#IV	BOQ
	WT. OF WET SOIL & DISH	845.5	820.4
	WT. OF DRY SOIL & DISH	680.7	685.5
	NET LOSS OF MOISTURE	164.8	134.9
	WT. OF DISH	46.4	46.2
	WT. OF DRY SOIL	634.3	639.3
	MOISTURE CONTENT (% DRY WT.)	26.0	21.1

% SATURATED [illegible] 1.5

FIGURE 3.26

Pbp

DAMES & MOORE

TRIAXIAL TEST DATA SHEET
LOW PRESSURE-ENGLISH

Owner DAVID J. NEWTON ASSOC. INC.

Job # 16170 - 001 - 041

Location

Boring # 2

Sample # 9

Depth 25' 3" TO 25' 9"

FROM "GRAVELS" BENEATH CLAY IN BORING B-2

Deflecting Speed — in/Hr Min

Lateral Pressure 1300 PSF ~~PSI~~

Saturated ☒ Field Moisture ☒

Set-Up 9-21-87 Tested WL (03 Office)

Soil Type

BR SM/ML W/ GRAVEL

		Initial	Final	
Weight soil & dish no. 932			886.6	
Dry weight soil & dish			722.9	
Net loss of moisture		121.6	163.7	
Weight of dish only			111.2	
Net weight of dry soil		616.7	611.7	
Moisture, % of dry weight		19.9	26.8	
~~Wt. solids~~ + moisture	W_0'	733.3	775.4	gms.
$W_0 \div 454$	W_0'			lbs.
Weight solids	W_s			gms.
Wet density $W_0' \div V_0'$		115.2		pcf
Dry Density		96.1	97.5	pcf
Net diameter	D_0	2.416		in.
Area ($0.785\ D_0^2$)	A_0	4.584		sq. in.
Height	H_0	5.29		in.
Volume (A_0H_0) ÷ 1728	V_0'			cu. ft.
Volume (A_0H_0) x 16.4	V_0			cc
Specific gravity of solids	G_s			
Volume of solids $W_s \div G_s$	V_s			cc
$(V_0 - V_s) \div V_s$	e_i			
Initial burette reading				cc
Burette reading under pressure				cc
$(V_p - V_s) \div V_s$	e_p			

902.0
− 168.7

% SATURATED IN FIELD ~ 71%

7.22
− 1.93

FIGURE 3.27

FORM NO. 857.40 (5-78) FOR E.D. 77-6

Pbp

DAMES & MOORE

TRIAXIAL TEST DATA SHEET
LOW PRESSURE-ENGLISH

FROM "GRAVELS" IN BORING B-1

Owner: DAVID T. NEWTON ASSOC I.

Job #: 16130-001-C41

Location:

Boring #: 1

Sample #: 19 A

Depth: 50' 9" TO 51' 3"

Deflecting Speed: — in/Hr/Min

Lateral Pressure: 2600 PSF ~~PSI~~

Saturated ☒ Field Moisture ☐

Set-Up: 1-21-17 Tested: WL (DS Office)

Soil Type: SM

7.47
-1.94

	Initial	Final
Weight soil & dish no. 914		918.8
Dry weight soil & dish		760.0
Net loss of moisture	65.8	158.8
Weight of dish only		110.8
Net weight of dry soil	649.2	649.2
Moisture, % of dry weight	10.1	24.5

% SATURATION IN FIELD ~ 41%

		Initial	Final	
Wt. solids + moisture	W_0'	715.0	808.0	gms.
$W_0 \div 454$	W_0'			lbs.
Weight solids	W_s			gms.
Wet density $W_0' \div V_0'$		107.4		pcf
Dry Density		97.6	100.3	pcf
Net diameter	D_0	2.416		in.
Area ($0.785\ D_0^2$)	A_0	4.584		sq. in.
Height	H_0	5.53		in.
Volume $(A_0H_0) \div 1728$	V_0'			cu. ft.
Volume $(A_0H_0) \times 16.4$	V_0			cc
Specific gravity of solids	G_s			
Volume of solids $W_s \div G_s$	V_s			cc
$(V_0 - V_s) \div V_s$	ei			
Initial burette reading				cc
Burette reading under pressure				cc
$(V_p - V_s) \div V_s$	ep			

GRAVELLY

SM w/o GRAVEL

FIGURE 3.28

FORM NO. 857.40 (5-78) FOR E.D. 77-6

PLP

DAMES & MOORE

TRIAXIAL TEST DATA SHEET
LOW PRESSURE-ENGLISH

FROM "GRAVELS" IN BORING B-6

Owner DAVID J. NEWTON ASSOC. INC.
Job # 16170 - 001 - 041
Location
Boring # 6
Sample # 16A
Depth 43'3" TO 43'9"

Deflecting Speed — in/Hr Min
Lateral Pressure 2200 PSF ~~PSI~~
Saturated ☒ Field Moisture ☒
Set-Up 1-1-7 Tested WL (G Office)
Soil Type SM W/ GRAVEL

7.72
−1.94

		Initial	Final	
Weight soil & dish no. 915			970.2	
Dry weight soil & dish			801.7	
Net loss of moisture		112.7	168.5	
Weight of dish only			112.4	
Net weight of dry soil		689.3	689.3	
Moisture, % of dry weight		16.4	24.4	
Wt. solids + moisture	W_0	802.0	857.8	gms.
$W_0 \div 454$	W_0'			lbs.
Weight solids	W_s			gms.
Wet density $W_0' \div V_0'$		115.4		pcf
Dry Density		99.2	100.6	pcf
Net diameter	D_0	2.415		in.
Area $(0.785\ D_0^2)$	A_0	4.581		sq. in.
Height	H_0	5.78		in.
Volume $(A_0H_0) \div 1728$	V_0'			cu. ft.
Volume $(A_0H_0) \times 16.4$	V_0			cc
Specific gravity of solids	G_s			
Volume of solids $W_s \div G_s$	V_s			cc
$(V_0 - V_s) \div V_s$	ei			
Initial burette reading				cc
Burette reading under pressure				cc
$(V_p - V_s) \div V_s$	ep			

% SATURATION IN FIELD ~ 67%

971.1
−169.1

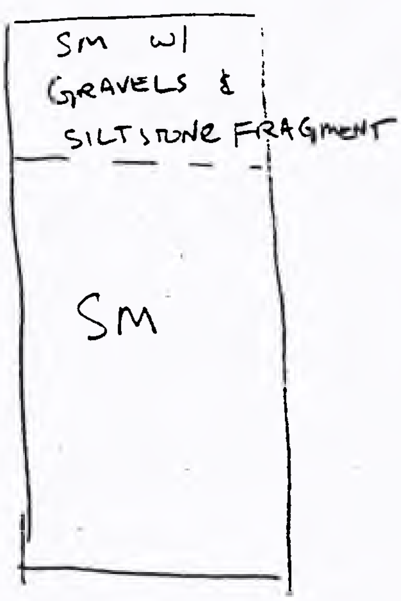


FIGURE 3.29

Pbp

DAMES & MOORE

TRIAXIAL TEST DATA SHEET
LOW PRESSURE-ENGLISH

Owner DAVID J. NEWTON ASSOC IN.
Job # 16170 - 001 - 041
Location
Boring # 1
Sample # 9
Depth 27.0 - 27.5

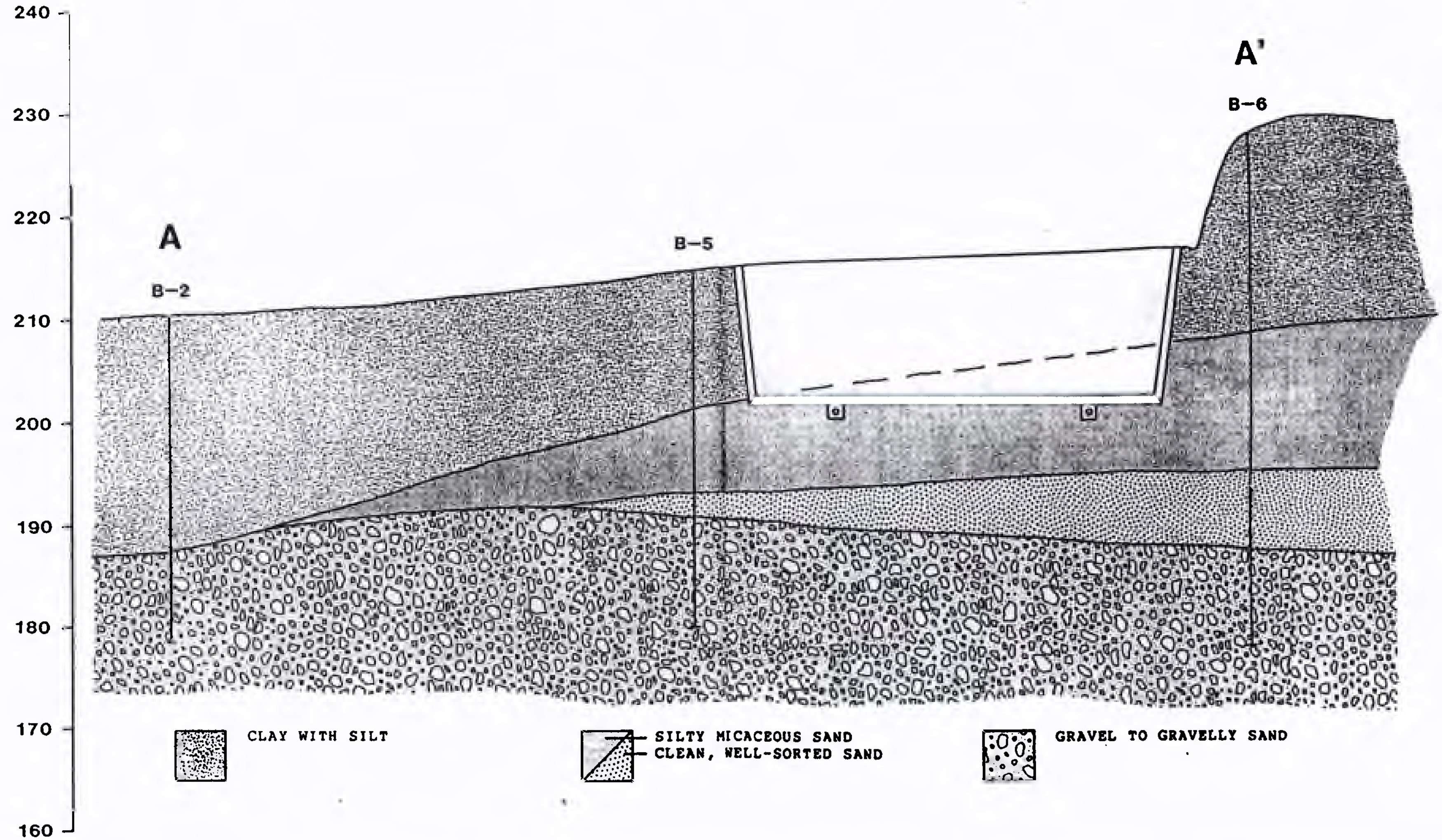
FROM CLAY UNIT IN BORING B-1

Deflecting Speed — in/Hr Min
Lateral Pressure 2100 PSF ~~PSI~~
Saturated ☒ Field Moisture ☐
Set-Up 9-21-87 Tested WL (03 Office)
Soil Type
~~(SC)~~ ML/CL

		Initial	Final
Weight soil & dish no. AR7			1126.5
Dry weight soil & dish			901.2
Net loss of moisture		212.4	225.3
Weight of dish only			106.4
Net weight of dry soil		796.0	794.8
Moisture, % of dry weight		26.7	28.3
Wt. solds + moisture	W_0'	1008.4	1021.3 gms.
$W_0 \div 454$	W_0'		lbs.
Weight solids	W_s		gms.
Wet density $W_0' \div V_0'$		120.0	pcf
Dry Density		94.7	95.3 pcf
Net diameter	D_0	2.875	in.
Area $(0.785\ D_0^2)$	A_0	6.492	sq. in.
Height	H_0	4.93	in.
Volume $(A_0H_0) \div 1728$	V_0'		cu. ft.
Volume $(A_0H_0) \times 16.4$	V_0		cc
Specific gravity of solids	G_s		
Volume of solids $W_s \div G_s$	V_s		cc
$(V_0-V_s) \div V_s$	ei		
Initial burette reading			cc
Burette reading under pressure			cc
$(V_p - V_s) \div V_s$	ep		

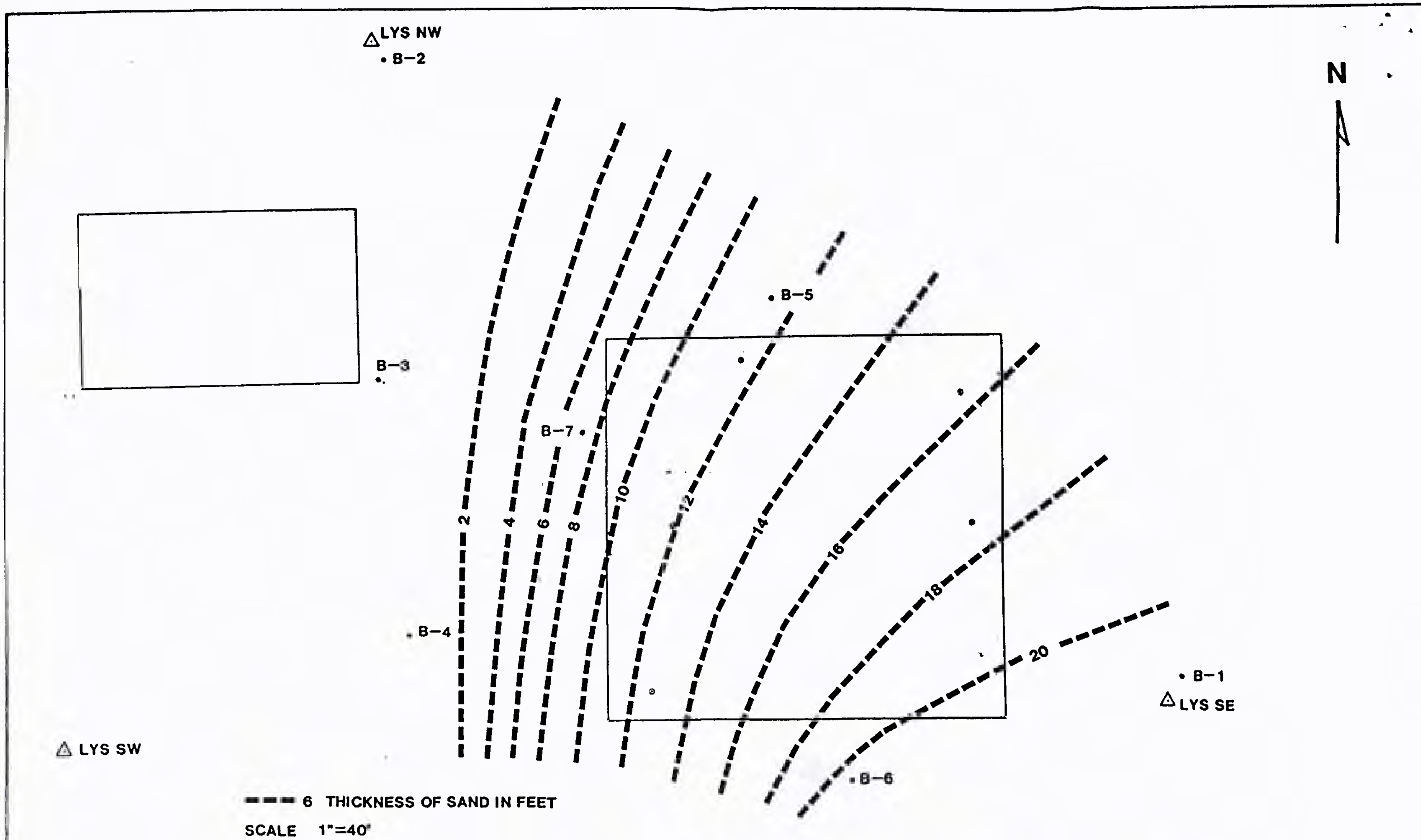
% SATURATION IN FIELD ~ 94%

FIGURE 3.30

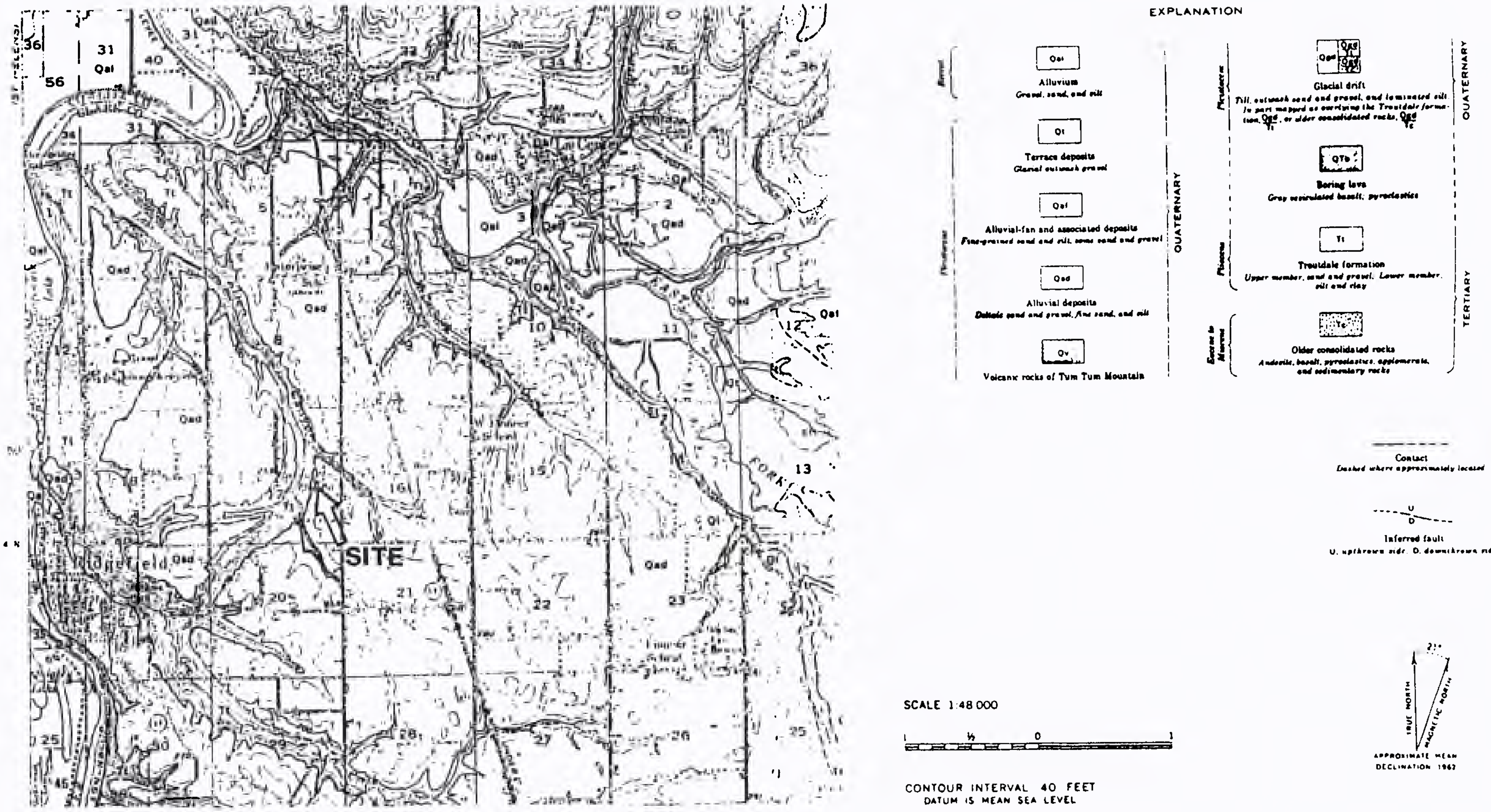


VERT. SCALE IN FEET 1"=10'
HORIZ. SCALE 1"=40'

DESIGNED BY	D. PETTIT	PROJECT NO.	213G131	DATE	DAVID J. NEWTON ASSOCIATES, INC.	SITE CROSS-SECTION A-A'	FIGURE
DRAWN BY	D. PETTIT	REVISED		9/22/87			4
APPROVED BY	D. NEWTON	REVISED					

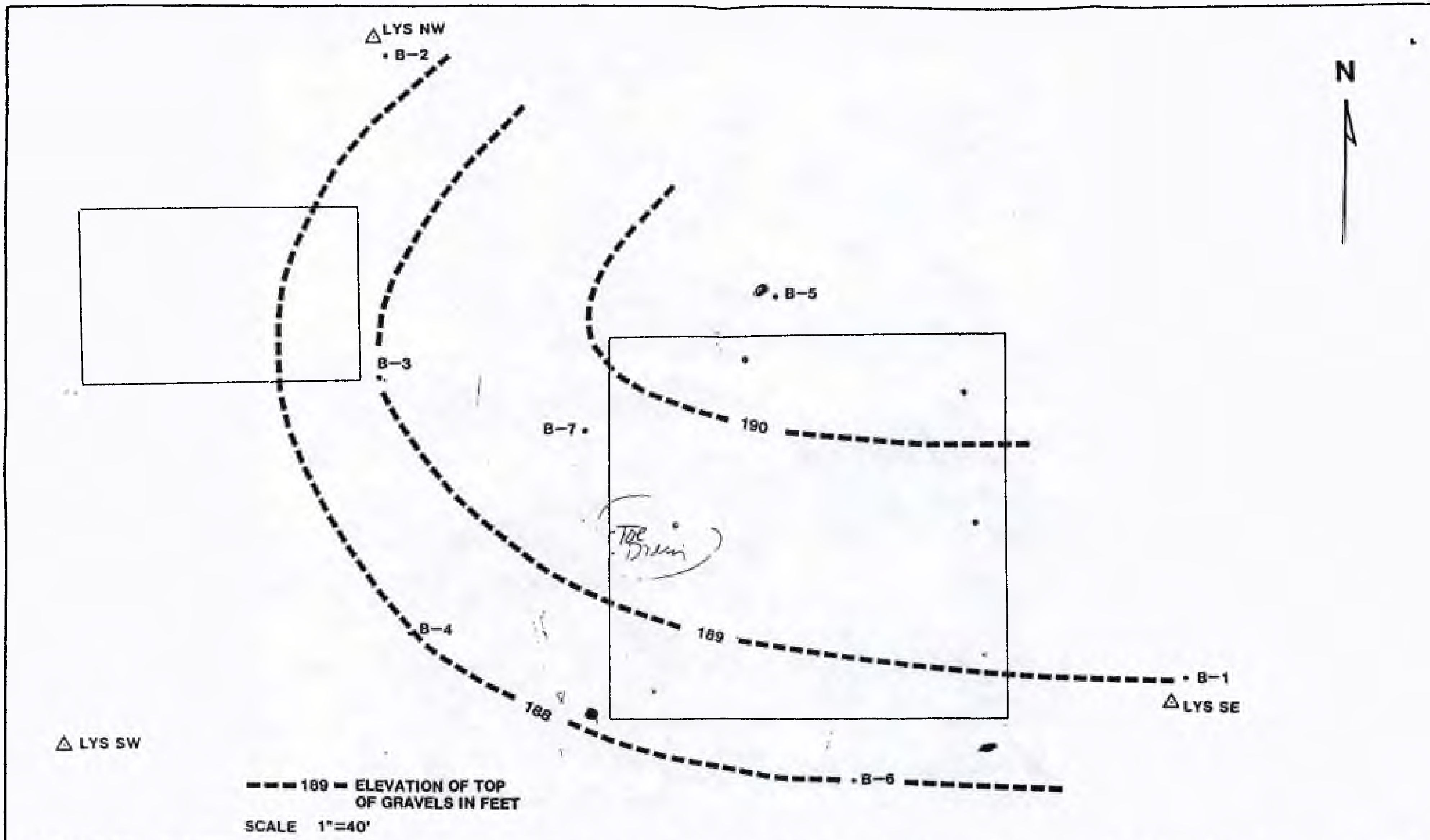


DESIGNED BY	D. PETTIT	PROJECT NO.	213GI31	DATE	DAVID J. NEWTON ASSOCIATES, INC.	THICKNESS CONTOURS OF SAND UNITS ABOVE TROUTDALE FORMATION	FIGURE
DRAWN BY	D. PETTIT	REVISED		9/22/87			5
APPROVED BY	D. NEWTON	REVISED					

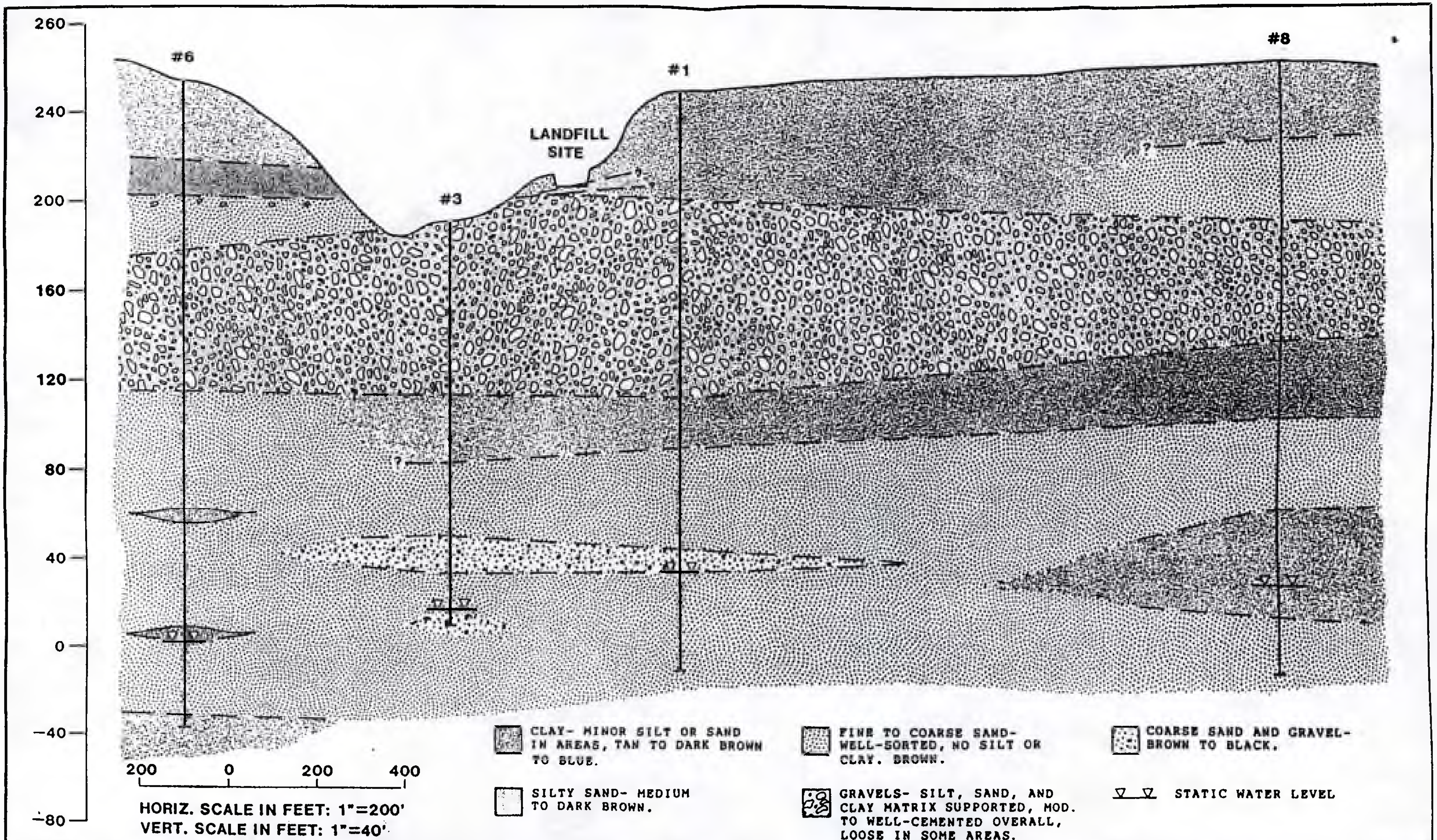


SOURCE: GEOLOGIC MAP OF WESTERN PART OF CLARK COUNTY, MUNDORFF, 1964
U.S. GEOLOGICAL SURVEY

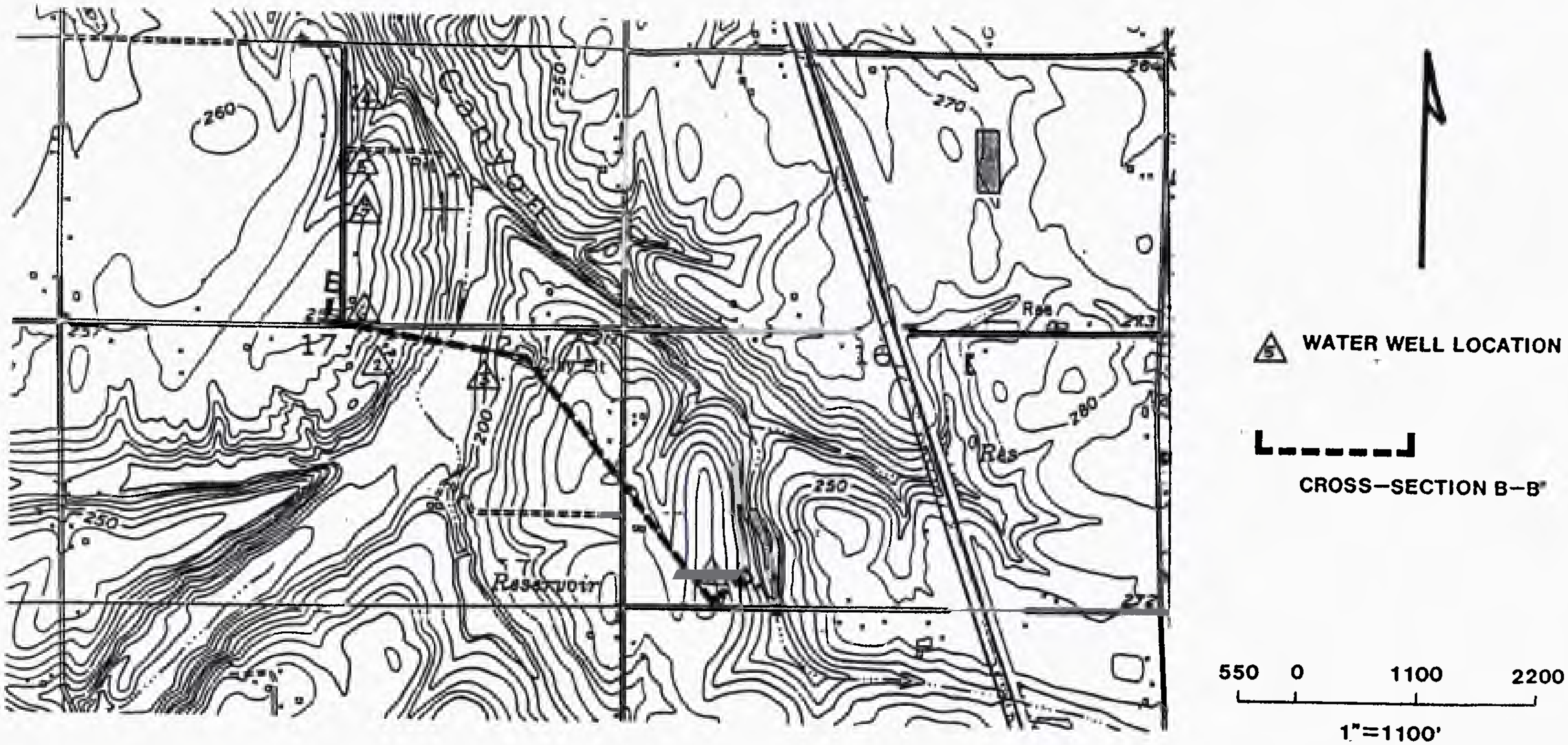
DESIGNED BY	D. PETTIT	PROJECT NO.	213GI31	DATE	DAVID J. NEWTON ASSOCIATES, INC.	REGIONAL GEOLOGY OF THE RIDGEFIELD, WASHINGTON AREA	FIGURE
DRAWN BY	D. PETTIT	REVISED		9/22/87			6
APPROVED BY	D. NEWTON	REVISED					



DESIGNED BY	D. PETTIT	PROJECT NO.	213GI31	DATE	DAVID J. NEWTON ASSOCIATES, INC.	APPROXIMATE SURFACE CONTOURS FOR TOP OF CEMENTED GRAVELS	FIGURE
DRAWN BY	D. PETTIT	REVISED		9/22/87			7
APPROVED BY	D. NEWTON	REVISED					

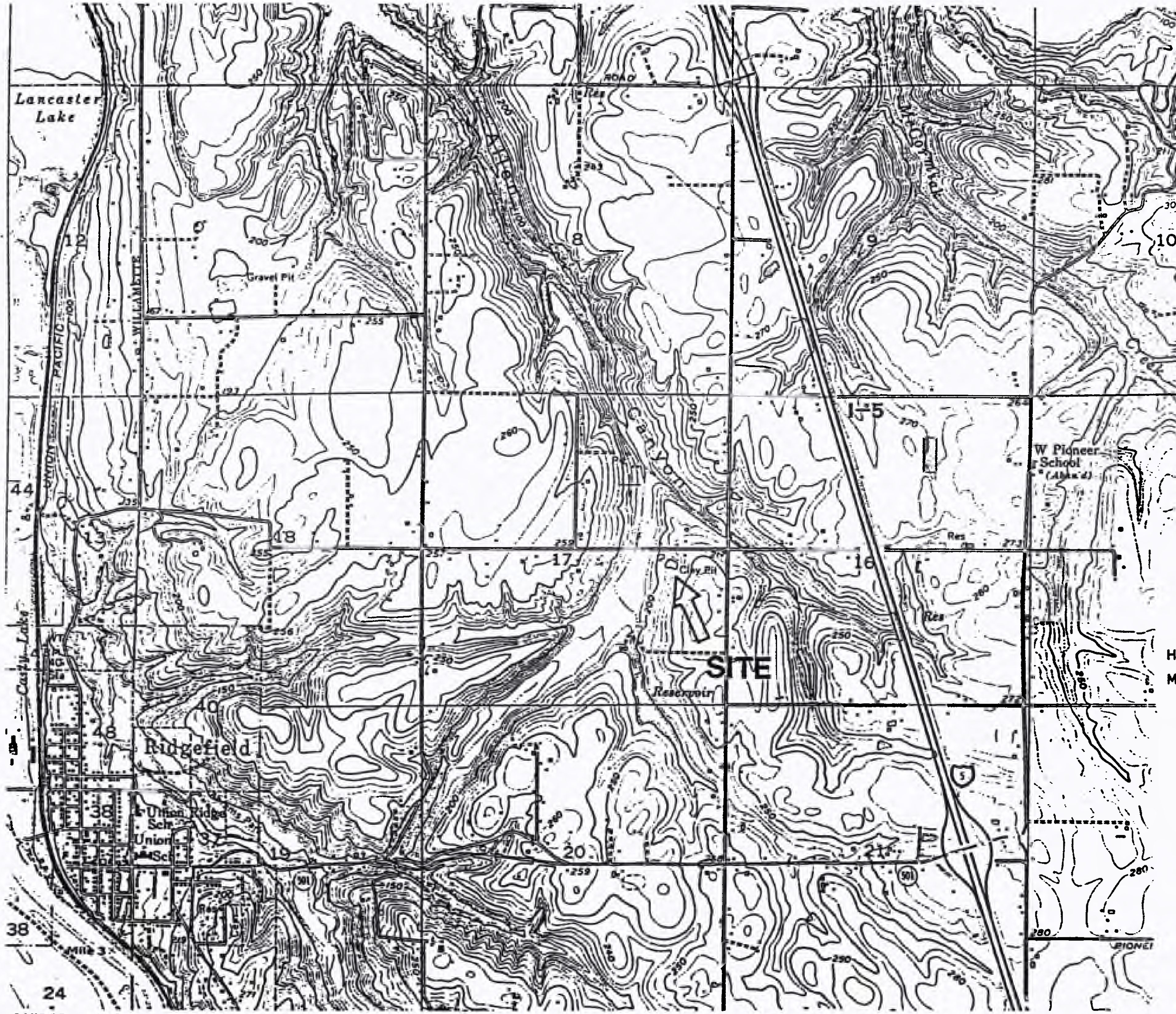


DESIGNED BY	D. PETTIT	PROJECT NO.	213GI31	DATE	DAVID J. NEWTON ASSOCIATES, INC.	GEOLOGY AND AQUIFER CONDITIONS AS REFLECTED IN DRILL LOGS.	FIGURE
DRAWN BY	D. PETTIT	REVISED		9/22 /87			8
APPROVED BY	D. NEWTON	REVISED					



DESIGNED BY	D. PETTIT	PROJECT NO.	213GI31	DATE	DAVID J. NEWTON ASSOCIATES, INC.	WATER WELL LOCATION AND REGIONAL CROSS-SECTION MAP	FIGURE
DRAWN BY	D. PETTIT	REVISED		9/22/87			9
APPROVED BY	D. NEWTON	REVISED					

VICINITY MAP

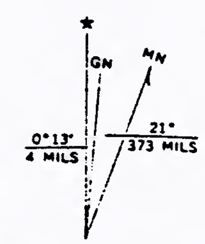


SOURCE: RIDGEFIELD QUADRANGLE, WA
7.5' SERIES TOPOGRAPHIC MAP
U.S. GEOLOGICAL SURVEY

EXPLANATION

ROAD CLASSIFICATION

Heavy-duty
Light-duty
Medium-duty
Unimproved dirt
Interstate Route
State Route



QUADRANGLE LOCATION

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL

DJN	12/88
DESIGNED	DATE
DJW	12/88
DRAWN	DATE
DJN	12/88
CHECKED	DATE

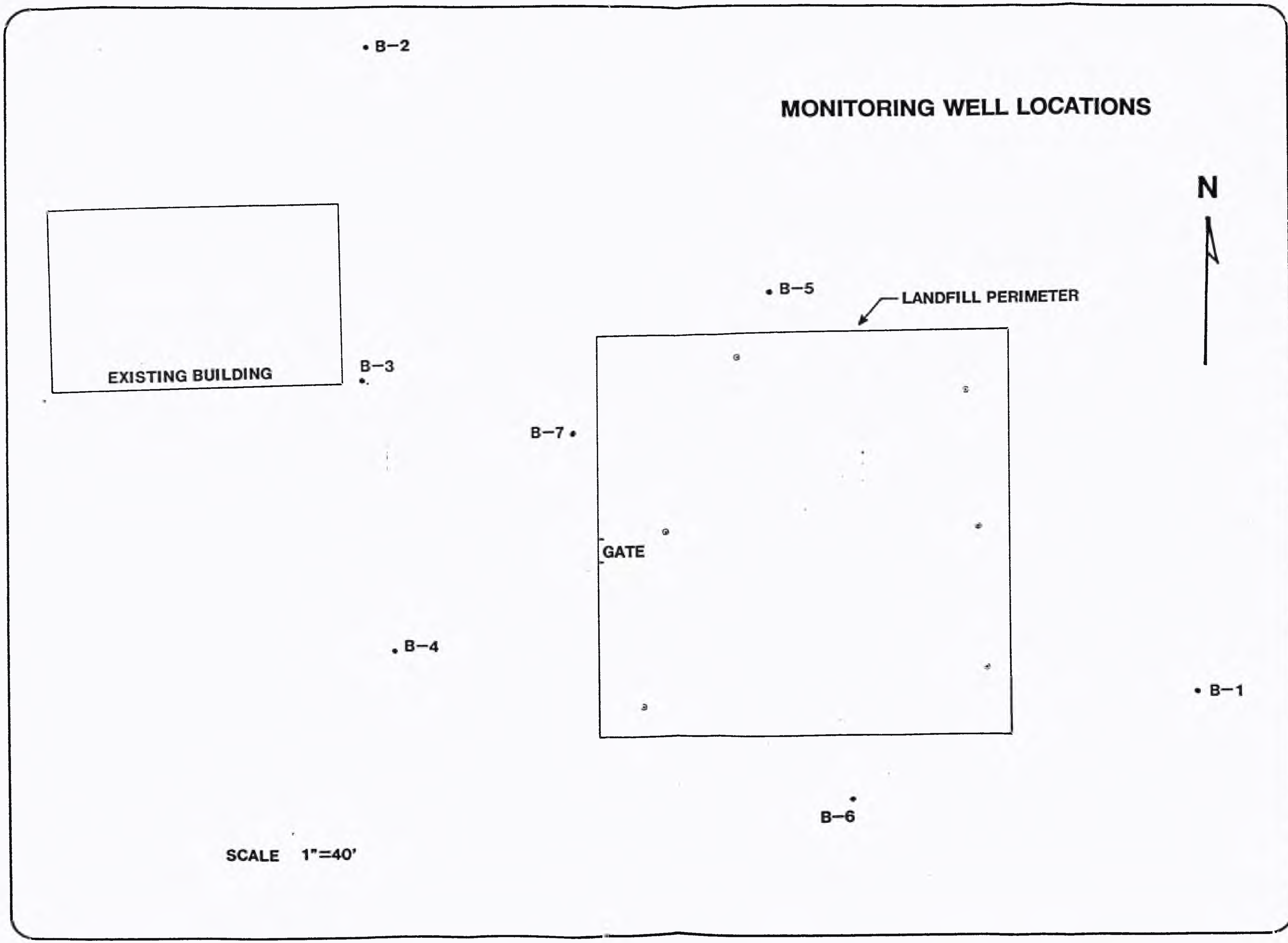
REVISIONS

DAVID J. NEWTON ASSOCIATES, INC.
CIVIL & GEOLOGICAL ENGINEERING
1201 SW 12TH AVENUE SUITE 620
PORTLAND, OR 97205
(503) 228-7718

Ridgefield Brick & Tile Site
Ridgefield, WA

SHEET NO.
Figure 1

PROJECT NO.



DJN	12/88
DESIGNED	DATE
DJW	12/88
DRAWN	DATE
DJN	12/88
CHECKED	DATE

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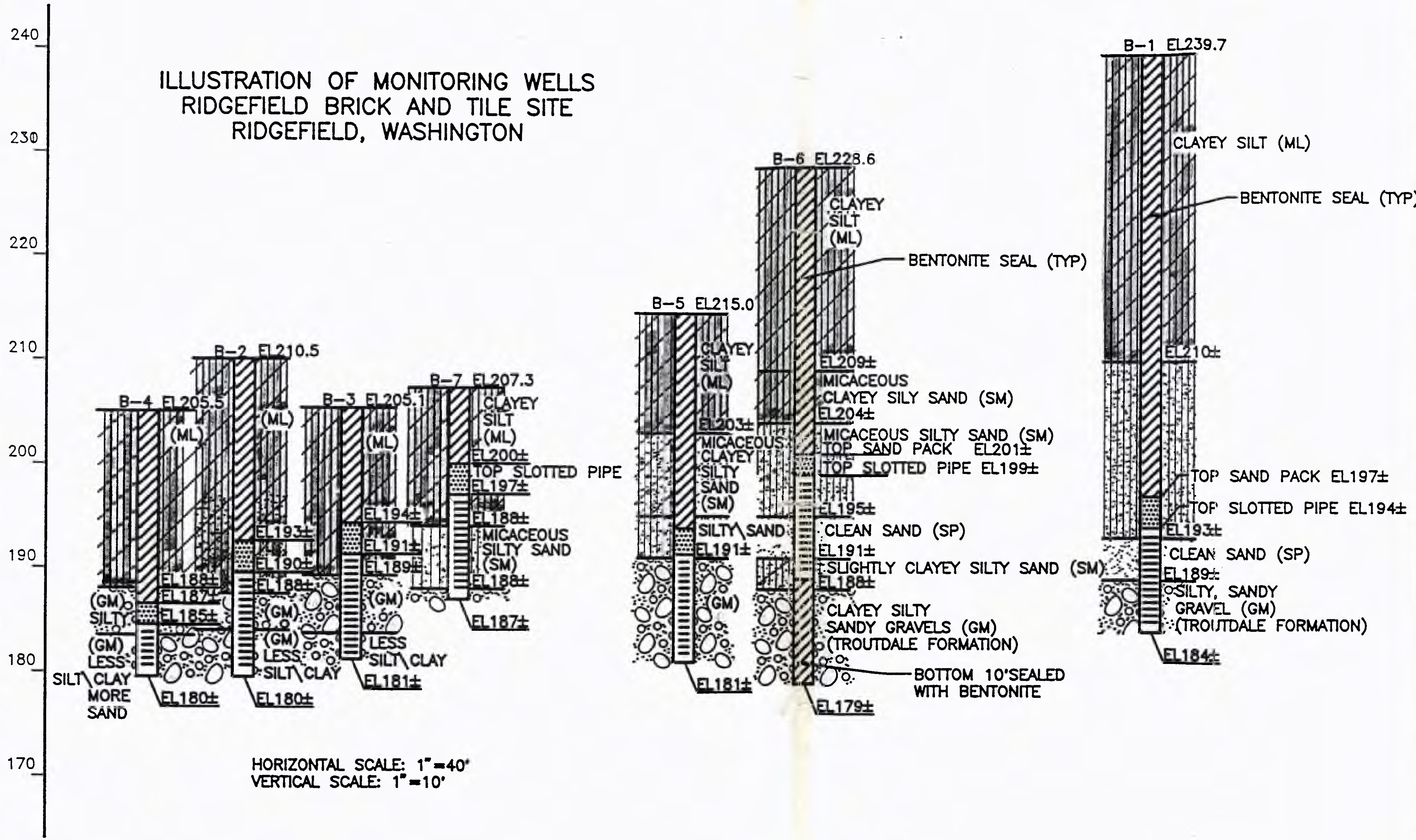
PORTLAND, OR 97205
(503) 228-7718

Ridgefield Brick & Tile Site
Ridgefield, WA

SHEET NO.
Figure 2

PROJECT NO.

ILLUSTRATION OF MONITORING WELLS
RIDGEFIELD BRICK AND TILE SITE
RIDGEFIELD, WASHINGTON



HORIZONTAL SCALE: 1"=40'
VERTICAL SCALE: 1"=10'

DJN	12/88
DESIGNED	DATE
BS	12/88
DRAWN	DATE
DJN	12/88
CHECKED	DATE

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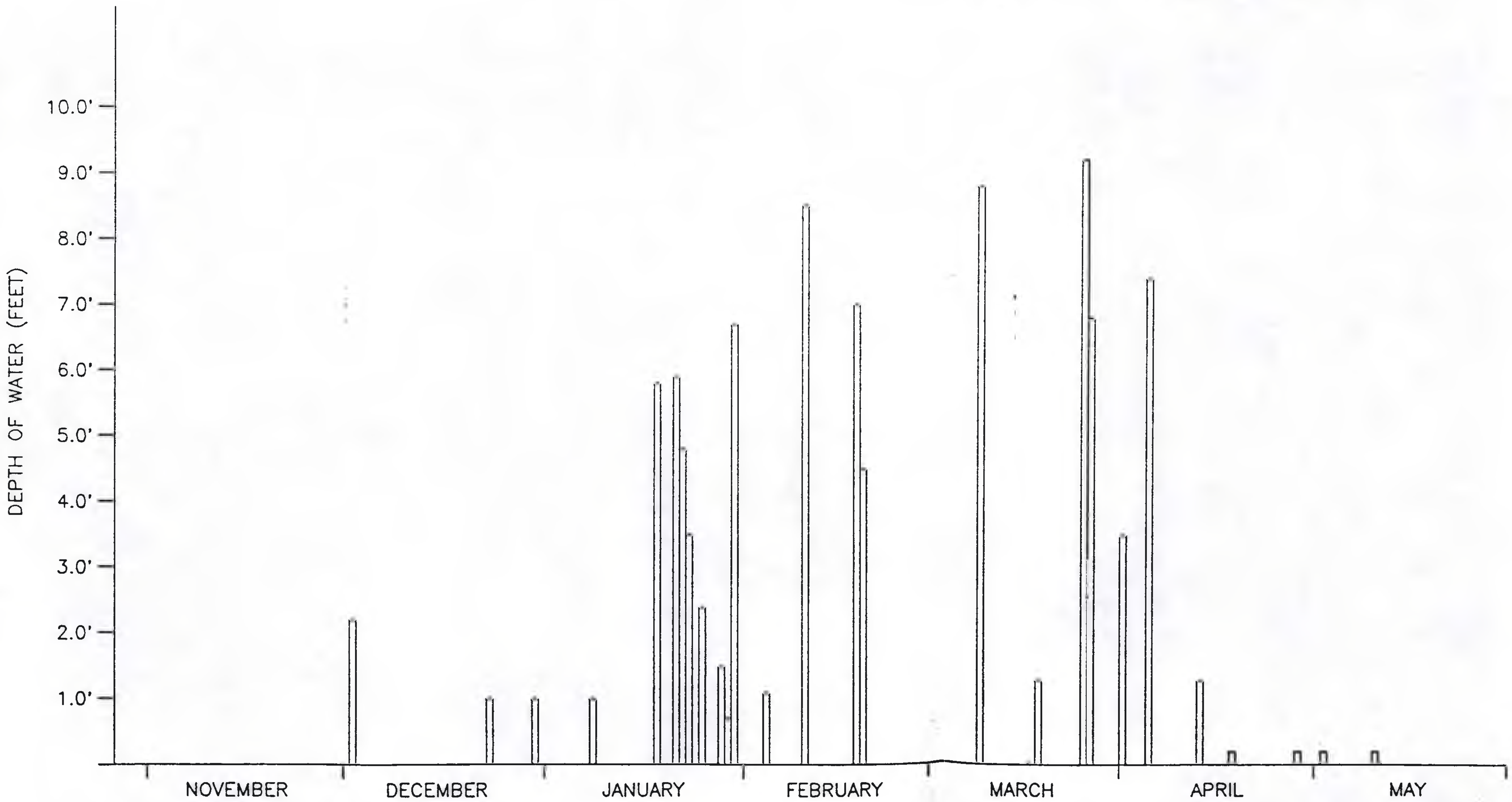
(503) 228-7718

Ridgefield Brick & Tile Site
Ridgefield, WA

SHEET NO.
Figure 3

PROJECT NO.

DEPTH OF WATER
BORING B-5, RBT SITE
RIDGEFIELD, WASHINGTON



DJN	12/88
DESIGNED	DATE
BS	12/88
DRAWN	DATE
DJN	12/88
CHECKED	DATE

REVISIONS

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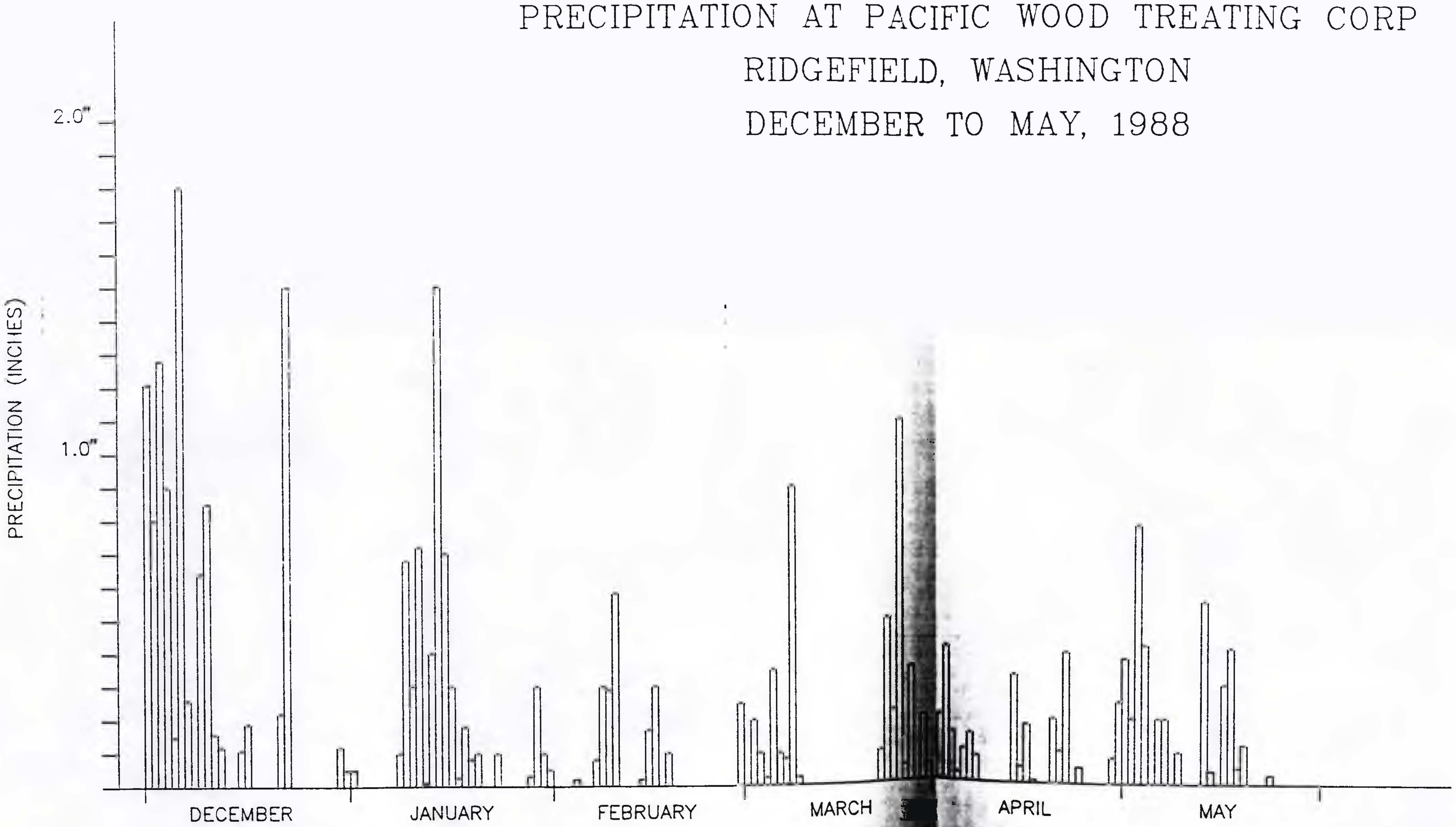
CIVIL & GEOLOGICAL ENGINEERING
1201 SW 12TH AVENUE SUITE 620
PORTLAND, OR 97205
(503) 228-7718

Ridgefield Brick & Tile Site
Ridgefield, WA

SHEET NO.

PRECIPITATION AT PACIFIC WOOD TREATING CORP
RIDGEFIELD, WASHINGTON
DECEMBER TO MAY, 1988



DJN	12/88
DESIGNED	DATE
BS	12/88
DRAWN	DATE
DJN	12/88
CHECKED	DATE

REVISIONS

DAVID J. NEWTON
ASSOCIATES, INC.
CIVIL & GEOLOGICAL ENGINEERING
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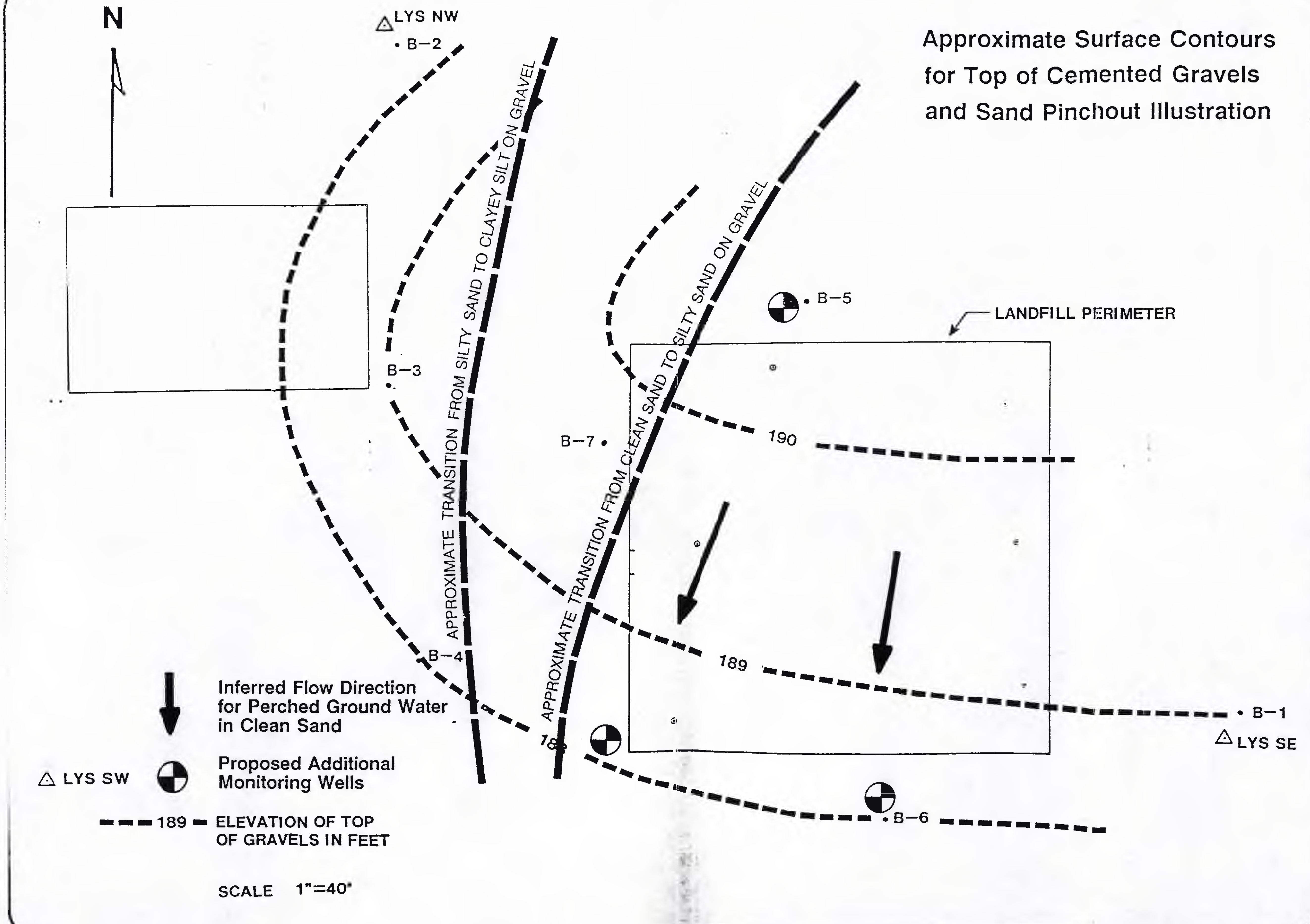
PORTLAND, OR 97205
(503) 228-7718

Ridgefield Brick & Tile Site
Ridgefield, WA

SHEET NO.
Figure 5

PROJECT NO.



Approximate Surface Contours for Top of Cemented Gravels and Sand Pinchout Illustration

DJN DESIGNED	12/88 DATE
DJW DRAWN	12/88 DATE
DJN CHECKED	12/88 DATE

REVISIONS

DAVID J. NEWTON ASSOCIATES, INC.
CIVIL & GEOLOGICAL ENGINEERING
1201 SW 12TH AVENUE SUITE 620
PORTLAND, OR 97205
(503) 228-7718

Ridgefield Brick & Tile Site
Ridgefield, WA

SHEET NO.
Figure 6

PROJECT NO.

APPENDIX

United States Testing Company, Inc.
Richland Division

2800 GEORGE WASHINGTON WAY
RICHLAND, WASHINGTON 99352 (509) 375-3131

LABORATORY SERVICES
RADIOCHEMISTRY
EXTERNAL DOSIMETRY
NUCLEAR SERVICES
RADIOBIOASSAY
AGRICULTURAL SERVICES
ANALYTICAL CHEMISTRY
POLLUTION CONTROL
HAZARDOUS SUBSTANCE ANALYSIS

February 16, 1988

Pacific Wood Treating Corp.
Attention: Bryant Adams
111 West Division St.
Ridgefield, WA 98642

Dear Mr. Adams:

Enclosed are the gross alpha and gross beta results on the water sample which was submitted to our laboratory for analysis.

If you have any questions or comments, please call me at (509) 375-3131/

Sincerely,

UNITED STATES TESTING COMPANY, INC.

Robert G. Swoboda
Manager
Environmental Radiochemistry

RGS:dal

Enclosure

xc: File

OUR LETTERS AND REPORTS ARE FOR THE EXCLUSIVE USE OF THE CLIENT TO WHOM THEY ARE ADDRESSED, AND THEY AND THE NAME OF THE UNITED STATES TESTING COMPANY, INC. OR ITS SEALS OR INSIGNIA, ARE NOT TO BE USED UNDER ANY CIRCUMSTANCES IN ADVERTISING TO THE GENERAL PUBLIC AND MAY NOT BE USED IN ANY OTHER MANNER WITHOUT OUR PRIOR WRITTEN APPROVAL. SAMPLES NOT DESTROYED IN TESTING ARE RETAINED A MAXIMUM OF THIRTY DAYS.
MEMBER OF THE SGS GROUP (SOCIETE GENERALE DE SURVEILLANCE)

16-Feb-88 09:57 AM

UNITED STATES TESTING COMPANY INC.
2800 GEORGE WASHINGTON WAY, RICHLAND, WA
RADIOCHEMICAL ANALYSIS REPORT
Results reported on 880216

SAMPLE TYPE	CUST#	ISOTOPE		RESULT	COUNTING ERROR	OVERALL ERROR	ANALYSIS SIZE	PERCENT MOIST	SAM DATE
** Reported => 880216									
WATER	B-5	BETA	111	1.91E+00 PCI/L	1.63E+00	1.64E+00(2S)	2.00E-01 L		880129
WATER	B-5	LO-ALPHA	212	* 2.55E-01 PCI/L	5.44E-01	5.45E-01(2S)	2.00E-01 L		880129

2 Records listed

* Denotes a result less than the overall error(nS) specifies the level of error, 1 sigma or 2 sigma

Columbia Analytical Services, Inc.

1152 3rd Avenue • Longview, WA 98632 • (206) 577-7222

March 9, 1988

Bryant Adams
Pacific Wood Treating
111 West Division St.
Ridgefield, WA 98642

RE: Samples Submitted January 29, 1988

Dear Bryant:

Enclosed are the results of samples submitted to our lab on January 29, 1988. For your reference, our service request number for this work is 88075.

Please note that for both samples silver was measured just above the instrument detection limit. If the values reported are at a level of concern, we will re-analyze by a more sensitive method. An elevated detection limit was reported for sulfate due to a high color background.

Please call if you have any questions.

Respectfully submitted:
COLUMBIA ANALYTICAL SERVICES, INC.

Mike Shelton/sw

Mike Shelton

COLUMBIA ANALYTICAL SERVICES, INC.
1152 3RD AVE. LONGVIEW, WA 98632
(206) 577-7222

CLIENT: Pacific Wood Treating
--Bryant Adams

March 9, 1988

PROJECT: Ridgefield RBT Site

WORK ORDER #: 88075

Analytical Report
mg/L

Sample Name:	B-5	T-8
Lab Code:	075-1	075-2
pH	6.9	6.2
Conductivity (umhos/cm)	267	432
Chloride	8	14
Fluoride	0.18	0.10
Nitrate-N	4.2	0.08
Sulfate	<20	7
Total Phenols	<0.02	<0.02
TOC	<5	<5
TOX	0.046	0.066
Turbidity (NTU)	1670	159
Arsenic	<0.005	<0.005
Barium	1.5	0.10
Cadmium	0.014	0.006
Chromium	0.16	<0.01
Iron	168	13
Manganese	2.4	5.1
Mercury	0.0006	<0.0002
Lead	0.19	0.006
Selenium	<0.005	<0.005
Silver	0.014	0.013
Sodium	36	22
Total Coliforms org/100ml	>2400	4

Approved by: Stephen Vincent Date: 3/9/88

COLUMBIA ANALYTICAL SERVICES, INC.
1152 3RD AVE. LONGVIEW, WA 98632
(206) 577-7222

CLIENT: Pacific Wood Treating
--Bryant Adams
PROJECT: Ridgefield RBT Site

March 9, 1988

WORK ORDER #: 88075

Analytical Report
ug/L

Sample Name	Lab Code	Total Tetrachlorophenol	Pentachlorophenol	Naphthalene
B-5	075-1	<2	<1	<10
T-8	075-2	<2	<1	<10

Approved by: Mike Shelton Date: 3/9/88

COLUMBIA ANALYTICAL SERVICES, INC.
1152 3RD AVE. LONGVIEW, WA 98632
(206) 577-7222

CLIENT: Pacific Wood Treating
--Bryant Adams

PROJECT: Ridgefield RBT Site

March 9, 1988

WORK ORDER #: 88075

Analytical Results
ug/L
Pesticides/Herbicides

Sample Name:	B-5	T-8
Lab Code:	075-1	075-2
Gamma-BHC (Lindane)	<0.2	<0.2
Endrin	<0.8	<0.8
Methoxychlor	<1	<1
Toxaphene	<2	<2
2,4-D	<10	<10
Silvex	<2	<2

Approved by: Mike Shelton Date: 3/9/88

ENVIRONMENTAL PROTECTION AGENCY
Office of Enforcement

CHAIN OF CUSTODY RECORD

PROJ. NO.

PROJECT NAME: RIDGEFIELD RBT SITE

SAMPLERS: (Signature)

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CON-TAINERS	Herb + Pest	Pesticides	Metals	Coliform	TOX	TOC	REMARKS
B-5	1/29/88	3:00		X	North side RBT Landfill	7							
T-8	1/29/88	3:30		X		6							

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
	1/29/88 3:30	Bryant L Adams	Bryant L Adams	1-29-88 4:35 pm	1/29 4:35
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks	

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

ENVIRONMENTAL PROTECTION AGENCY
Office of Enforcement

CHAIN OF CUSTODY RECORD

PROJ. NO.	PROJECT NAME
	RBT

SAMPLERS: *(Signature)* Bryant Adams + Dave Newton

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	Gross α	Gross β	Radium				REMARKS
B-5	1-29-88	3:30		✓	2 89th St Ridgefield	1	✓	✓	✓				

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Bryant Adams	2-2-88 12:05		Francis L. England		

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*

Relinquished by: *(Signature)*	Date / Time	Received for Laboratory by: *(Signature)*	Date / Time	Remarks

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

Columbia Analytical Services, Inc.
1152 3rd Avenue • Longview, WA 98632 • (206) 577-7222

RECEIVED
MAR 14 1988
P.WT.

March 11, 1988

Bryant Adams
Pacific Wood Treating
111 West Division St.
Ridgefield, WA 98642

Dear Bryant:

Enclosed please find a revised report for our work order # 88075. We re-analyzed silver using graphite furnace and found no delectable silver.

Please call if you have any questions.

Respectfully submitted:
COLUMBIA ANALYTICAL SERVICES, INC.

Mike Shelton

Mike Shelton

Columbia Analytical Services, Inc.

1152 3rd Avenue • Longview, WA 98632 • (206) 577-7222

May 5, 1988

Bryant Adams
Pacific Wood Treating
111 West Division St.
Ridgefield, WA 98642

RE: Water Sample Submitted on April 6, 1988

Dear Bryant:

Enclosed are the results of the sample submitted to our lab on April 6, 1988. For your reference, our service request number for this work is 88296.

The replicate analysis for three specific tests are recorded separately.

Please call if you have any questions.

Respectfully submitted:
COLUMBIA ANALYTICAL SERVICES, INC.

Mike Shelton

Mike Shelton

COLUMBIA ANALYTICAL SERVICES, INC.
1152 3RD AVE. LONGVIEW, WA 98632
(206) 577-7222

CLIENT: Pacific Wood Treating
--Bryant Adams

PROJECT: Ridgefield RBT Site

March 11, 1988

WORK ORDER #: 88075

Analytical Report
mg/L

Sample Name:	B-5	T-8
Lab Code:	075-1	075-2
pH	6.9	6.2
Conductivity (umhos/cm)	267	432
Chloride	8	14
Fluoride	0.18	0.10
Nitrate-N	4.2	0.08
Sulfate	<20	7
Total Phenols	<0.02	<0.02
TOC	<5	<5
TOX	0.046	0.066
Turbidity (NTU)	1670	159
Arsenic	<0.005	<0.005
Barium	1.5	0.10
Cadmium	0.014	0.006
Chromium	0.16	<0.01
Iron	168	13
Manganese	2.4	5.1
Mercury	0.0006	<0.0002
Lead	0.19	0.006
Selenium	<0.005	<0.005
Silver	<0.01	<0.01
Sodium	36	22
Total Coliforms org/100ml	>2400	4

Approved by: Mike Shelton   Date: 3/11/88

COLUMBIA ANALYTICAL SERVICES, INC.
1152 3RD AVE. LONGVIEW, WA 98632
(206) 577-7222

CLIENT: Pacific Wood Treating
--Bryant Adams

PROJECT: Water Analysis

May 5, 1988

WORK ORDER #: 88296

Analytical Report
mg/L

Sample Name:	Northside Landfill RBT B-5
Lab Code:	296-1
Chloride	3
Conductivity (umhos/cm)	234
Fluoride	0.16
Nitrogen, Nitrate	0.14
TOC	8.1
TOX	0.005
Arsenic	<0.005
Barium	0.045
Cadmium	<0.005
Chromium	<0.01
Iron	0.67
Lead	<0.005
Manganese	0.06

Approved by: *Mike Shelton* Date: *5/5/88*

note: The Metals sample was filtered before sending to Columbia Anal.

- BJA

COLUMBIA ANALYTICAL SERVICES, INC.
1152 3RD AVE. LONGVIEW, WA 98632
(206) 577-7222

CLIENT: Pacific Wood Treating
--Bryant Adams

May 5, 1988

PROJECT: Replicate Analysis

WORK ORDER #: 88296

Analytical Report

Test: Units:	Conductivity umhos/cm	TOC mg/L	TOX mg/L
Analysis 1	234	6.5	0.006
Analysis 2	236	9.0	0.003
Analysis 3	234	9.0	0.006
Analysis 4	230	8.0	0.005
Analysis 5	-	-	0.003
Average	234	8.1	0.005
Standard Deviation	2.6	1.2	0.0015

Approved by: Mike Shelton Date: 5/5/88

ENVIRONMENTAL PROTECTION AGENCY
Office of Enforcement

CHAIN OF CUSTODY RECORD

PROJ. NO.	PROJECT NAME
	RBT

SAMPLERS: (Signature) Bryant Adams

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	Metals	sp cond NO3(N)	TOC TOX			REMARKS
B-5	4/5/88	15:20		✓	Northside Landfill	3						Run 4 replicate tests on TOC TOX spec. conduct.

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Bryant Adams	4/6/88 9:05				

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks
		Fran Adair	4/4/88 9:07	

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

United States Testing Company, Inc.
Richland Division
2800 GEORGE WASHINGTON WAY
RICHLAND, WASHINGTON 99352 (509) 375-3131

RADIOCHEMISTRY
EXTERNAL DOSIMETRY
NUCLEAR SERVICES
RADIOBIOASSAY
AGRICULTURAL SERVICES
ANALYTICAL CHEMISTRY
POLLUTION CONTROL
HAZARDOUS SUBSTANCE ANALYSIS

June 14, 1988

Pacific Wood Treating Corp.
Attn: Bryant Adams
111 West Divison St.
Ridgefield WA 98642

Dear Mr. Adams:

Enclosed are the gross alpha and gross beta results on the water sample which was submitted to our laboratory for analysis.

If you have any questions or comments, please call me at (509) 375-3131.

Sincerely,

UNITED STATES TESTING COMPANY, INC.

R. G. Swoboda by DA

Robert G. Swoboda
Manager
Environmental Radiochemistry

RGS:dal

Enclosure

xc: File

OUR LETTERS AND REPORTS ARE FOR THE EXCLUSIVE USE OF THE CLIENT TO WHOM THEY ARE ADDRESSED, AND THEY AND THE NAME OF THE UNITED STATES TESTING COMPANY, INC. OR ITS SEALS OR INSIGNIA, ARE NOT TO BE USED UNDER ANY CIRCUMSTANCES IN ADVERTISING TO THE GENERAL PUBLIC AND MAY NOT BE USED IN ANY OTHER MANNER WITHOUT OUR PRIOR WRITTEN APPROVAL. SAMPLES NOT DESTROYED IN TESTING ARE RETAINED A MAXIMUM OF THIRTY DAYS.
MEMBER OF THE SGS GROUP (SOCIETE GENERALE DE SURVEILLANCE)

UNITED STATES TESTING COMPANY INC.
2800 GEORGE WASHINGTON WAY, RICHLAND, WA
RADIOCHEMICAL ANALYSIS REPORT
Results reported on 880614

SAMPLE TYPE	CUST#	ISOTOPE		RESULT	COUNTING ERROR	OVERALL ERROR	ANALYSIS SIZE	PERCENT MOIST	SAMPLE DATE	SAMPLE TIME	ON DATE	ON TIME	U C	GROUP	LS #
** Reported => 880614															
WATER	T-8	BETA	111	1.51E+00 PCI/L	7.91E-01	8.04E-01(2S)	5.00E-01 L		880523	1450	880523	1450	I	103	054880
WATER	T-8	LO-ALPHA	212	3.83E-01 PCI/L	3.09E-01	3.12E-01(2S)	5.00E-01 L		880523	1450	880523	1450	I	103	054880

2 Records listed

* Denotes a result less than the overall error(nS) specifies the level of error, 1 sigma or 2 sigma

Columbia Analytical Services, Inc.
1152 3rd Avenue • Longview, WA 98632 • (206) 577-7222

RECEIVED
JUN 30 1988
P.W.T.

June 27, 1988

Bryant Adams
Pacific Wood Treating
111 West Division St.
Ridgefield, WA 98642

RE: Ridgefield RBT Site Project

Dear Bryant:

Enclosed are the results of the sample submitted to our lab on May 23, 1988. For your reference, our service request number for this work is 88452.

Please call if you have any questions.

Respectfully submitted:
COLUMBIA ANALYTICAL SERVICES, INC.

Steve

S. W. Vincent

COLUMBIA ANALYTICAL SERVICES, INC.
1152 3RD AVE. LONGVIEW, WA 98632
(206) 577-7222

CLIENT: Pacific Wood Treating
--Bryant Adams
PROJECT: Ridgefield RBT Site

June 27, 1988

WORK ORDER #: 88452

Analytical Report

Sample Name:	T-8
Lab Code:	452-1
Pentachlorophenol	0.002
Total Tetrachlorophenol	<0.006
Naphthalene	<0.010
Endrin	<0.0001
Lindane	<0.0001
Methoxychlor	<0.0003
Toxaphene	<0.001
2,4-D	<0.05
Silvex	<0.01

Approved by S W Vincent Date 6/27/88

COLUMBIA ANALYTICAL SERVICES, INC.
1152 3RD AVE. LONGVIEW, WA 98632
(206) 577-7222

CLIENT: Pacific Wood Treating
--Bryant Adams
PROJECT: Ridgefield RBT Site

June 27, 1988

WORK ORDER #: 88452

Analytical Report
mg/L

Sample Name:	T-8
Lab Code:	452-1
pH	6.2
Conductivity (umhos/cm)	337
Chloride	10
Fluoride	0.12
Nitrogen, Nitrate	0.07
Phenols, Total	<0.02
Sulfate	5
TOC	66
TOX	0.052
Turbidity	7
Coliforms, Total (org/100ml)	70
Arsenic	0.006
Barium	0.069
Cadmium	<0.01
Chromium	<0.01
Iron	8.0
Lead	<0.005
Manganese	3.5
Mercury	<0.0002
Selenium	<0.005
Silver	<0.01
Sodium	15

Approved by Steve Vincent Date 6/27/88

ENVIRONMENTAL PROTECTION AGENCY
Office of Enforcement

CHAIN OF CUSTODY RECORD

PROJ. NO.	PROJECT NAME
	Ridgefield WA RBT

SAMPLERS: (Signature) Bryant L Adams

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS							REMARKS
	5-23	1245			T-8	6							

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Bryant L Adams	5-23-85 3:00 P.M				

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks
		[illegible signature]	5-23-85 3:01	

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

ENVIRONMENTAL PROTECTION AGENCY
Office of Enforcement

CHAIN OF CUSTODY RECORD

SAMPLING - Chain of Custody

PROJ. NO.	PROJECT NAME
	Ridgefied WA RBT

SAMPLERS: (Signature) Bryant L Adams

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CON-TAINERS							REMARKS
	5-23	1:40			T-8	1							

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Bryant Adams	5-23-82 2:00 PM	J Heidenberg			

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files